

WLAN TEST REPORT

Report Number: 103017087LEX-004
Project Number: G103017087

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Product Name: Wireless Base Station

FCC Standards: FCC Title 47 CFR Part 15.247
Industry Canada Standards: RSS-247 Issue 2 & RSS-GEN Issue 4

Tested by:
Intertek Testing Services NA, Inc.
731 Enterprise Drive
Lexington, KY 40510

Client:
Alcohol Monitoring Systems Inc.
1241 W Mineral Ave
Littleton, CO 80120

Report prepared by



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1 Introduction and Conclusion

The tests indicated in section 2 were performed on the product constructed as described in section 3. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test method, a list of the actual test equipment used, documentation photos, results and raw data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested complied with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested.

The INTERTEK-Lexington is located at 731 Enterprise Drive, Lexington Kentucky, 40510. The radiated emission test site is a 10-meter semi-anechoic chamber. The chamber meets the characteristics of CISPR 16-1 and ANSI C63.4. For measurements, a remotely controlled flush-mount metal-top turntable is used to rotate the EUT a full 360 degrees. A remote controlled non-conductive antenna mast is used to scan the antenna height from one to four meters. The test site is listed with the FCC under registration number 485103. The test site is listed with Industry Canada under site number IC 2042M-1.

2 Test Summary

Page	Test full name	FCC Reference	IC Reference	Result
6	Peak Conducted Power	§ 15.247(b)(3)(4)	RSS-247 (5.4)	Pass
8	Occupied Bandwidth	§ 15.247(a)(2)	RSS-247 (5.2(A)) RSS-GEN (4.6.1)	Pass
12	Conducted Spurious Emissions	§ 15.247(d)	RSS-247 (5.5)	Pass
19	Power Spectral Density	§ 15.247(e)	RSS-247 (5.2(B))	Pass
23	Radiated Spurious Emissions (Transmitter)	§ 15.247(d), § 15.209, and § 15.205	RSS-247 (5.5)	Pass
30	Radiated Spurious Emissions (Receiver)	§ 15.109	RSS-Gen (6.1)	Pass
32	AC Powerline Conducted Emissions	§ 15.107, § 15.207	RSS-Gen (7.2.4)	Pass
38	Antenna Requirement per FCC Part 15.203	§ 15.203	RSS-Gen (7.1.2)	Pass

3 Description of Equipment Under Test

Equipment Under Test	
Manufacturer	Alcohol Monitoring Systems Inc.
Model Number	BS-400
Serial Number	WB1002W
Receive Date	5/8/2017
Test Start Date	5/8/2017
Test End Date	5/17/2017
Device Received Condition	Good
Test Sample Type	Production
Frequency Band	2412MHz – 2462MHz
Mode(s) of Operation	802.11b,g,n
Modulation Type	BPSK, QPSK, CCK, OFDM
Duty Cycle	100%
Transmission Control	Test Commands
Maximum Output Power	22.01dBm
Maximum Antenna Gain ¹	3.6dBi
Test Channels	1,6,11
Antenna Type (15.203)	PCB Antenna
Operating Voltage	120Vac 60Hz

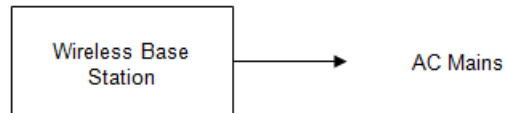
Description of Equipment Under Test

The SCRAM CAM bracelet, SCRAM Base Station, and SCRAM Wireless Base Station are part of an alcohol monitoring system and transfers data to a computerized monitoring network. This equipment is intended for use on individuals being monitored by a trained supervising authority.

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	Transmitting 802.11 b, g or n on low, mid or high channels
2	Receive mode / idle mode

¹ From antenna datasheet

3.1 System setup including cable interconnection details, support equipment and simplified block diagram**3.2 EUT Block Diagram:****3.3 Cables:**

Cables					
Description	Length	Shielding	Ferrites	Connection	
				From	To
Power Cable	1m	No	No	EUT	AC Mains

3.4 Support Equipment:

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
Laptop	HP	EliteBook 8440p	CND046136B

4 Peak Conducted Power

4.1 Test Limits

§ 15.247(b)(3): For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.

§ 15.247(b)(4): The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

4.2 Test Procedure

ANSI C63.10: 2013 and KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247). The peak output power was measured using a receiver in spectrum analyzer mode.

4.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	10887490.26	Rohde & Schwarz	ESI26	9/20/2016	9/20/2017

4.4 Test Data:

Mode	Frequency (MHz)	Channel Number	Type	Conducted Power (dBm)
802.11b	2412	1	Peak	17.98
	2437	6	Peak	19.15
	2462	11	Peak	18.72
802.11g	2412	1	Peak	19.67
	2437	6	Peak	22.01
	2462	11	Peak	19.50
802.11n	2412	1	Peak	15.82
	2437	6	Peak	18.21
	2462	11	Peak	16.97

5 Occupied Bandwidth

5.1 Test Limits

§ 15.247(a)(2): For digital modulation systems, the minimum 6dB bandwidth shall be at least 500kHz.

5.2 Test Procedure

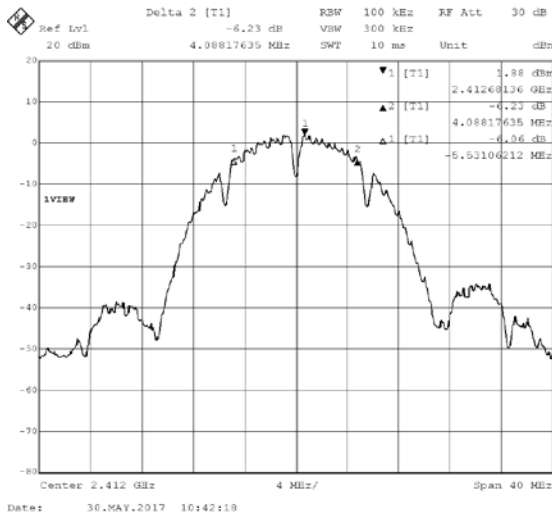
ANSI C63.10: 2013 and KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)

5.3 Test Equipment Used:

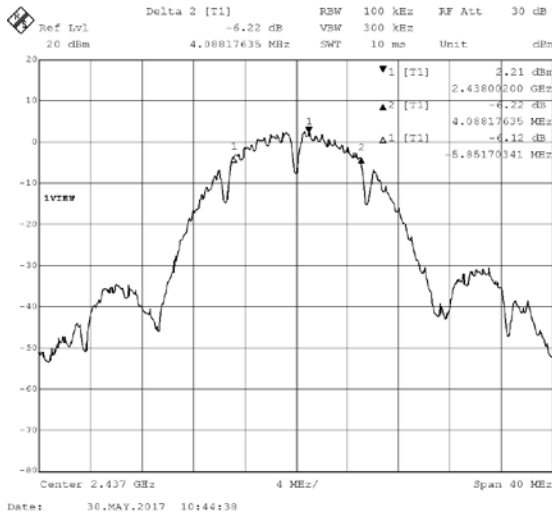
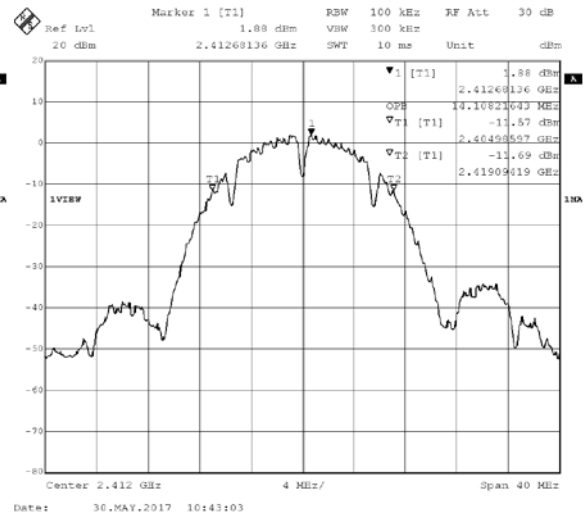
Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	10887490.26	Rohde & Schwarz	ES126	9/20/2016	9/20/2017

5.4 Results:

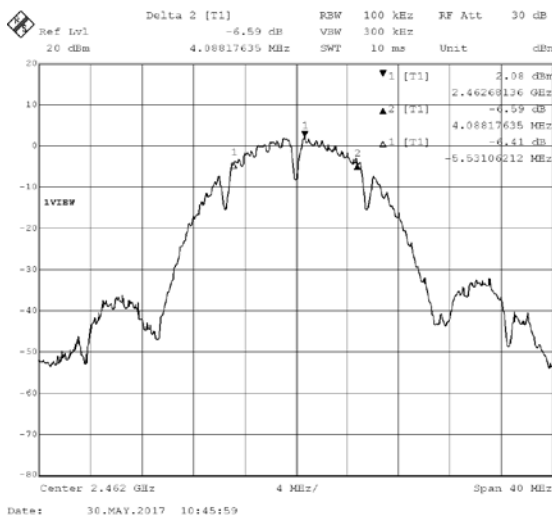
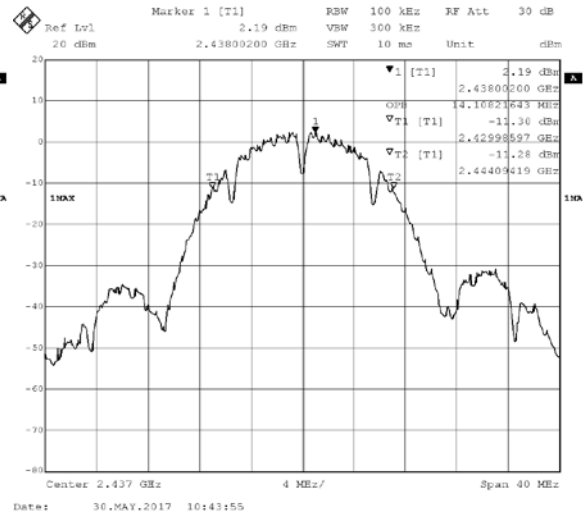
Mode	Channel Number	Frequency (MHz)	6dB Bandwidth (MHz)	99% Power Bandwidth (MHz)	Result
802.11b	1	2412	9.619	14.108	Pass
802.11b	6	2437	9.940	14.108	Pass
802.11b	11	2462	9.619	14.108	Pass
802.11g	1	2412	15.310	16.352	Pass
802.11g	6	2437	15.310	16.593	Pass
802.11g	11	2462	15.231	16.352	Pass
802.11n	1	2412	16.674	16.513	Pass
802.11n	6	2437	17.673	16.753	Pass
802.11n	11	2462	16.594	16.593	Pass



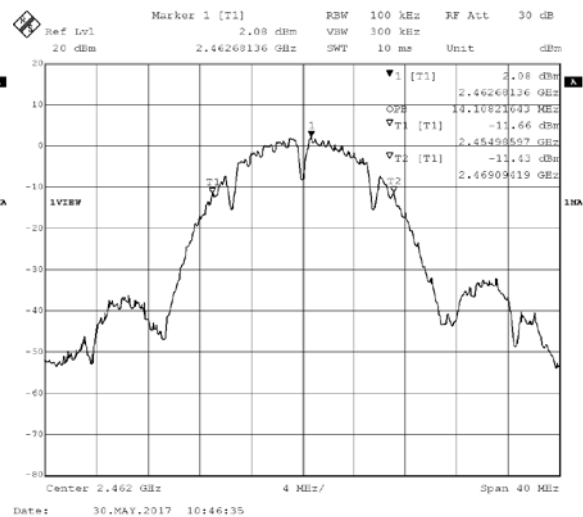
6dB and 99% Power Bandwidth Plot (Channel 1) – 802.11b mode

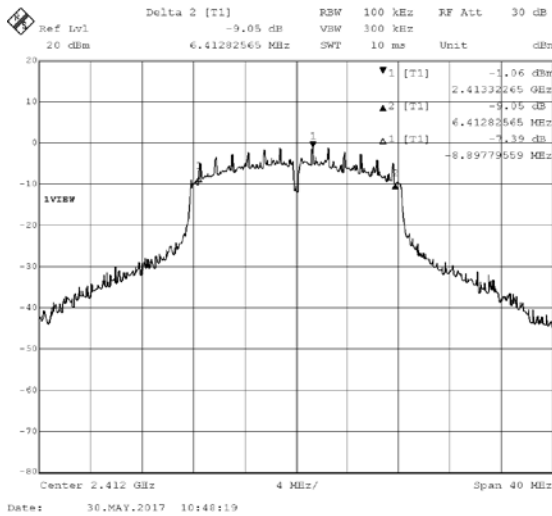


6dB and 99% Power Bandwidth Plot (Channel 6) – 802.11b mode

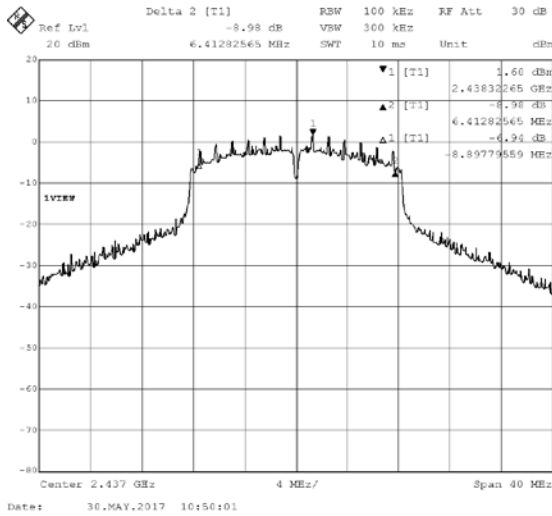
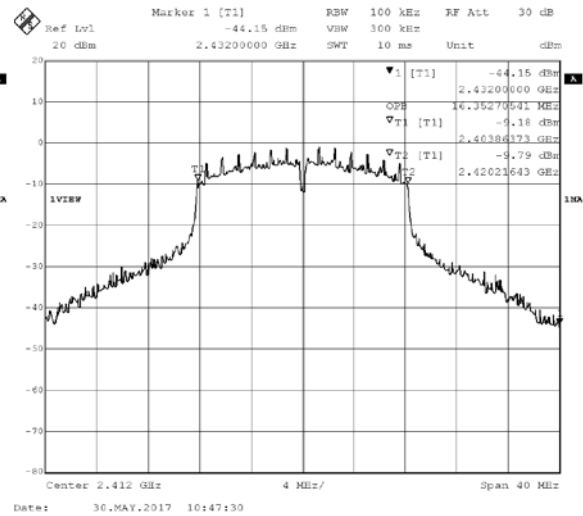


6dB and 99% Power Bandwidth Plot (Channel 11) – 802.11b mode

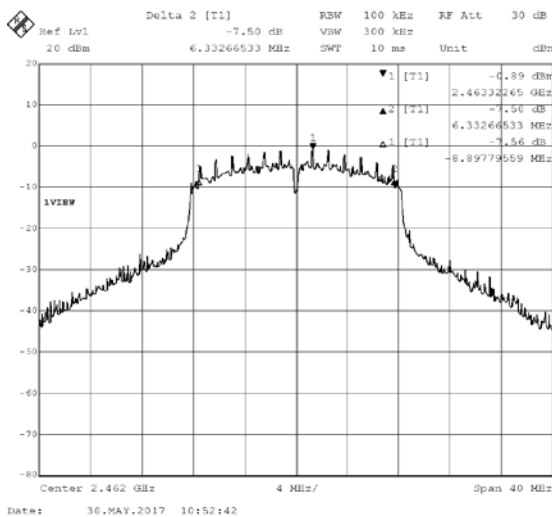
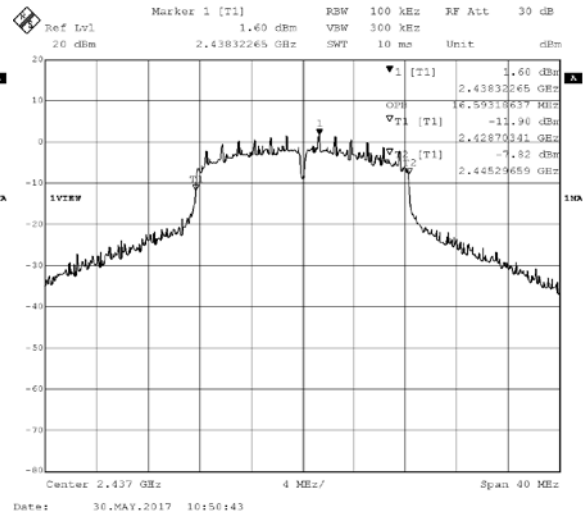




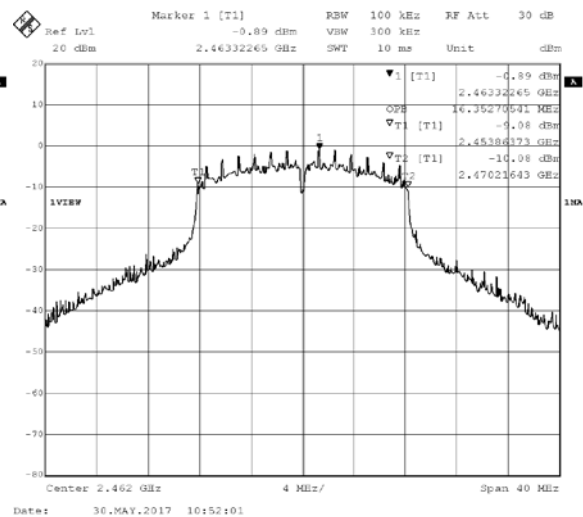
6dB and 99% Power Bandwidth Plot (Channel 1) – 802.11g mode

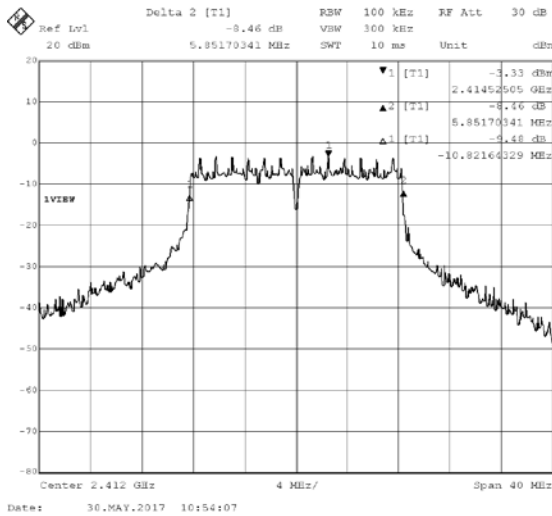


6dB and 99% Power Bandwidth Plot (Channel 6) – 802.11g mode

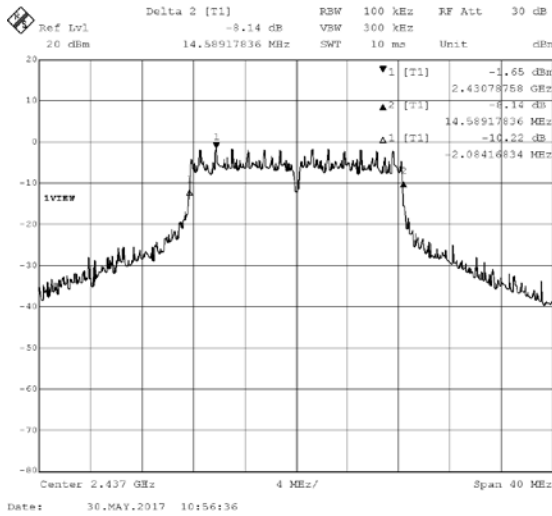
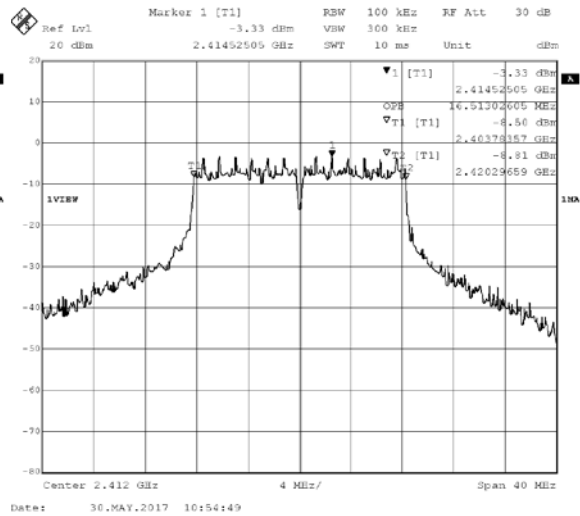


6dB and 99% Power Bandwidth Plot (Channel 11) – 802.11g mode

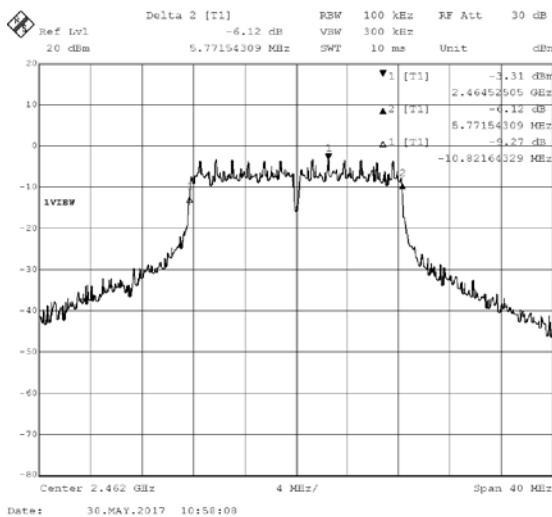
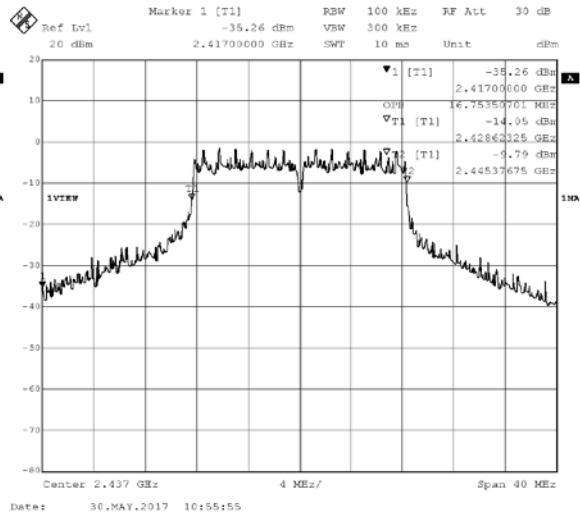




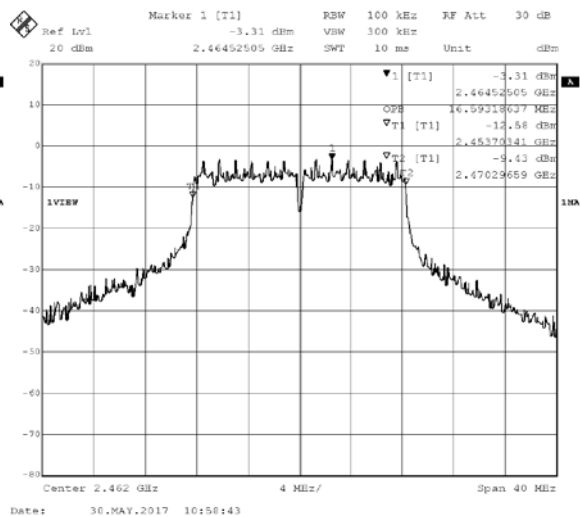
6dB and 99% Power Bandwidth Plot (Channel 1) – 802.11n mode



6dB and 99% Power Bandwidth Plot (Channel 6) – 802.11n mode



6dB and 99% Power Bandwidth Plot (Channel 11) – 802.11n mode



6 Conducted Spurious Emissions

6.1 Test Limits

§ 15.247(d): In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

6.2 Test Procedure

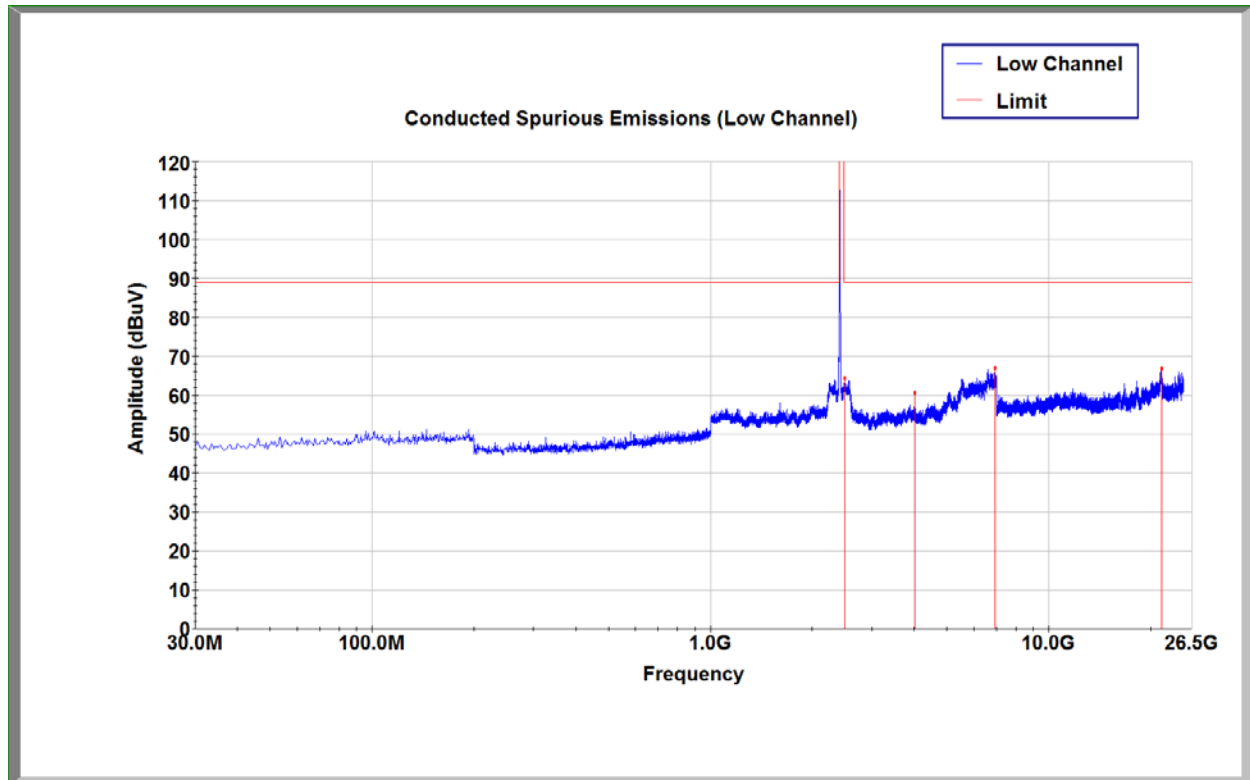
ANSI C63.10: 2013 and KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)

6.3 Test Equipment Used:

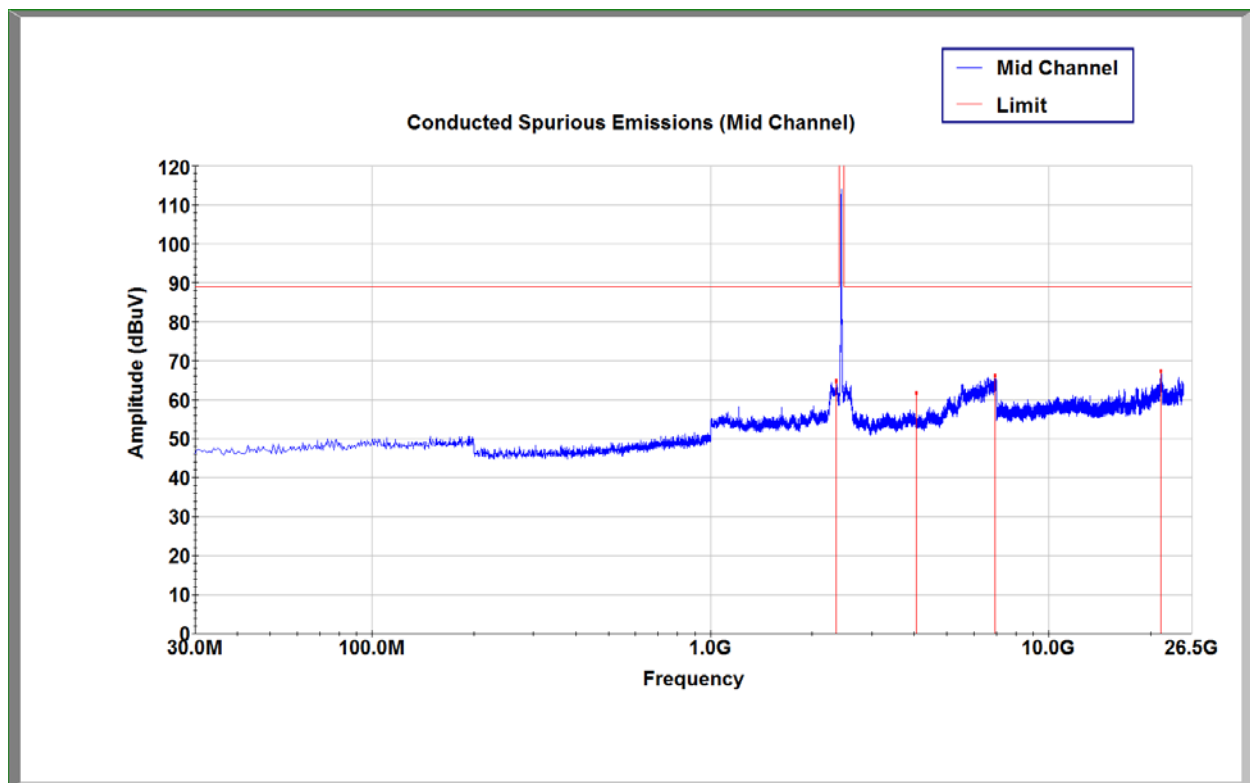
Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	10887490.26	Rohde & Schwarz	ESI26	9/20/2016	9/20/2017

6.4 Results:

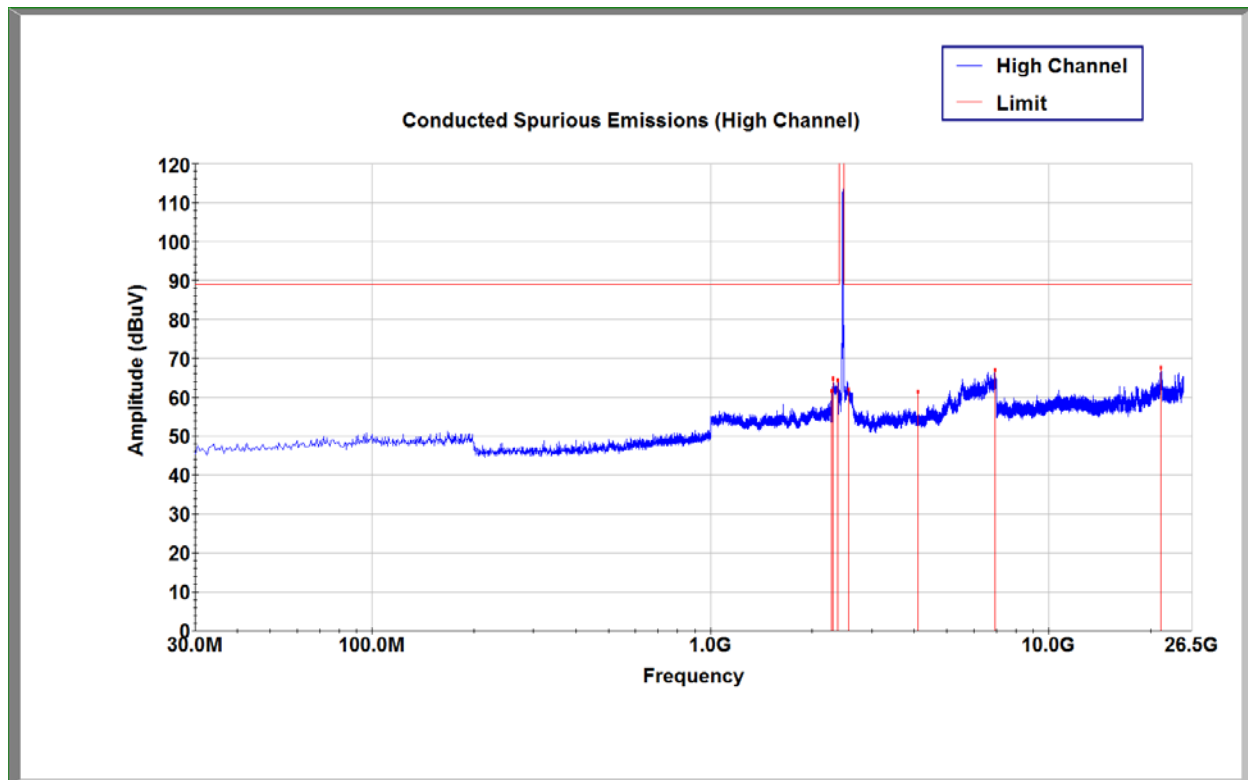
The following plots show that there are no conducted spurious emissions exceeding the 20dB down criteria.



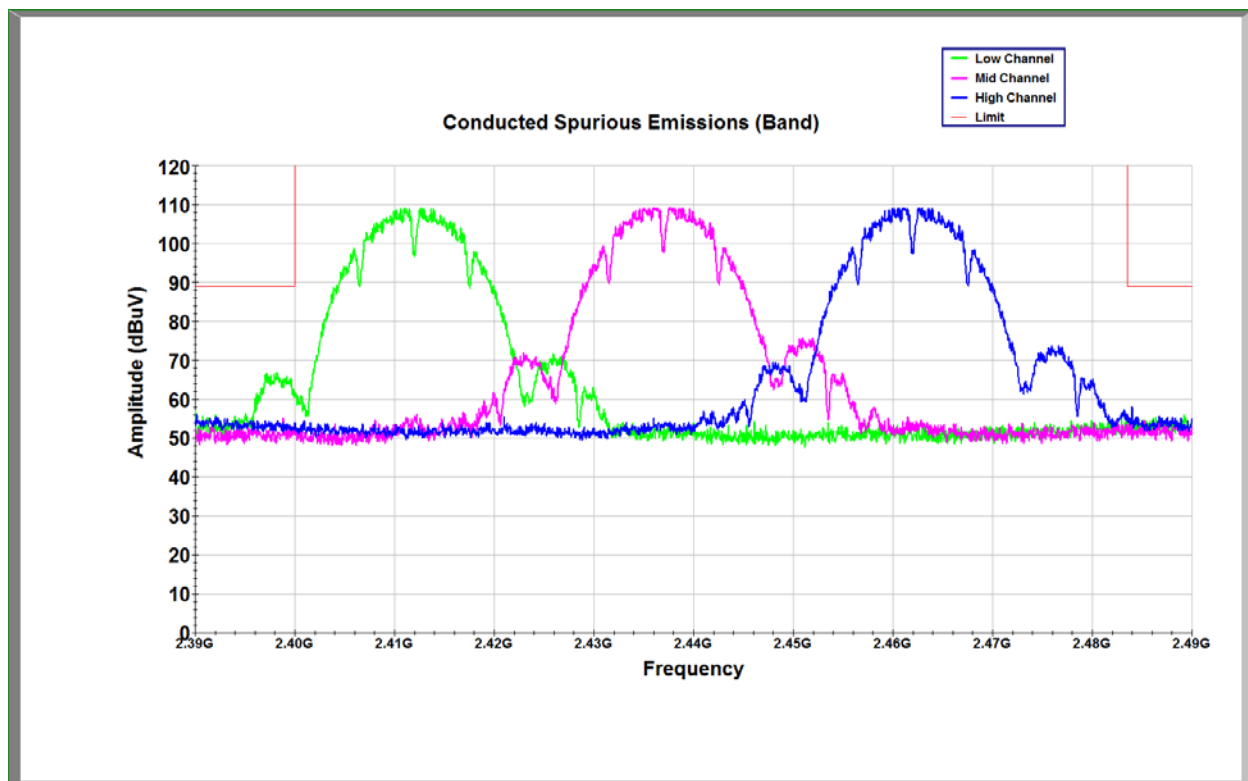
Low Channel Conducted Spurious Emissions - 802.11b Mode



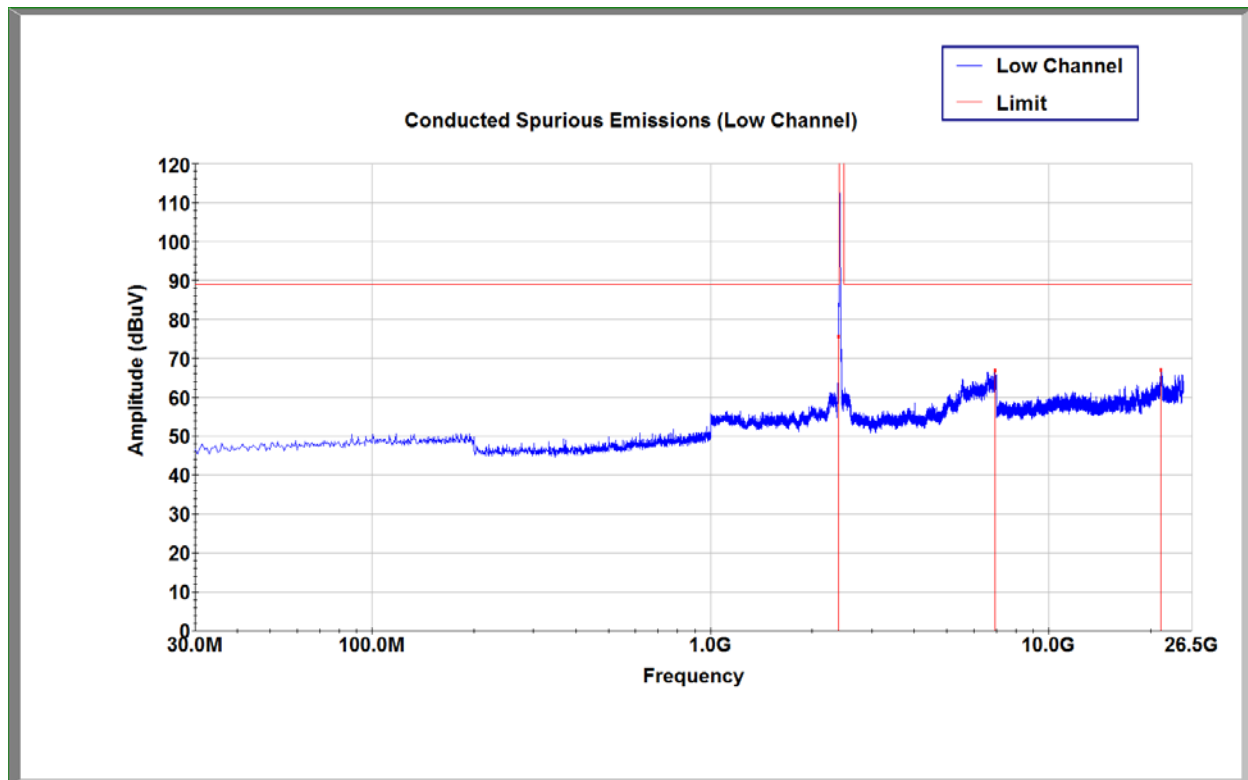
Mid Channel Conducted Spurious Emissions - 802.11b Mode



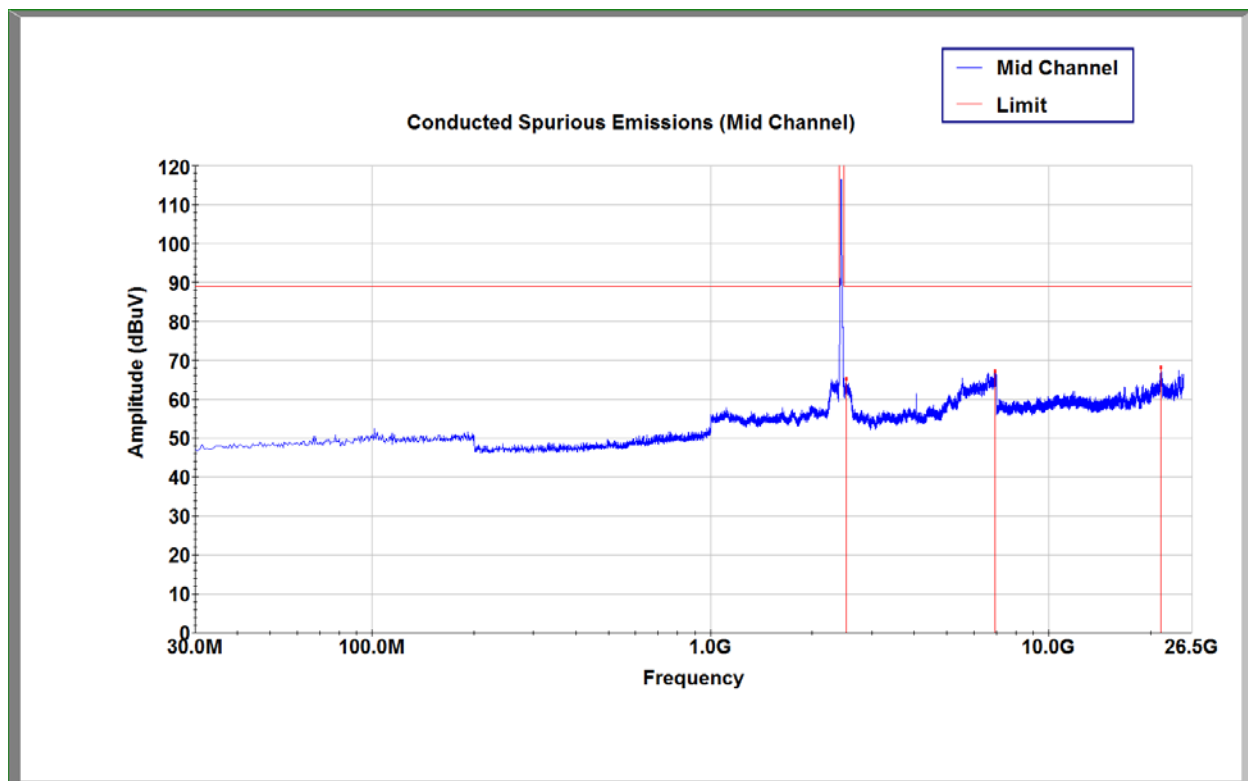
High Channel Conducted Spurious Emissions - 802.11b Mode



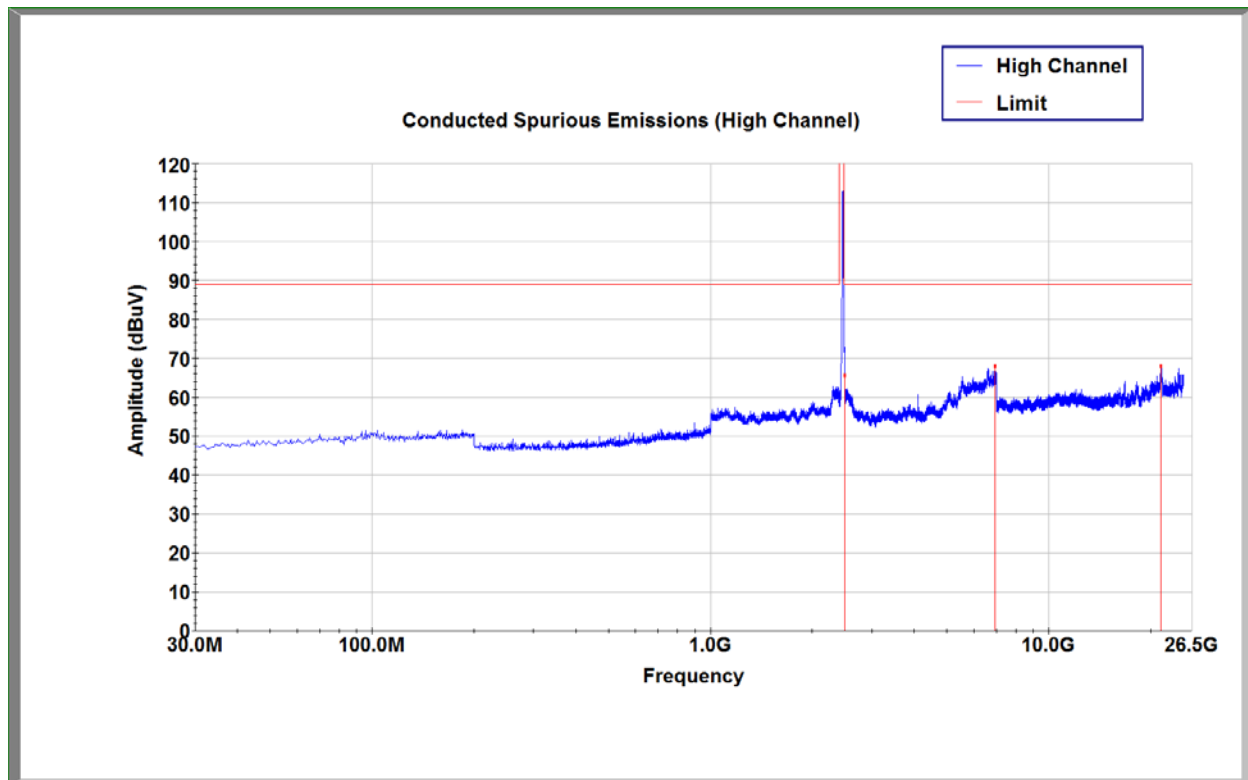
Emissions Close to Band Edge – 802.11b Mode



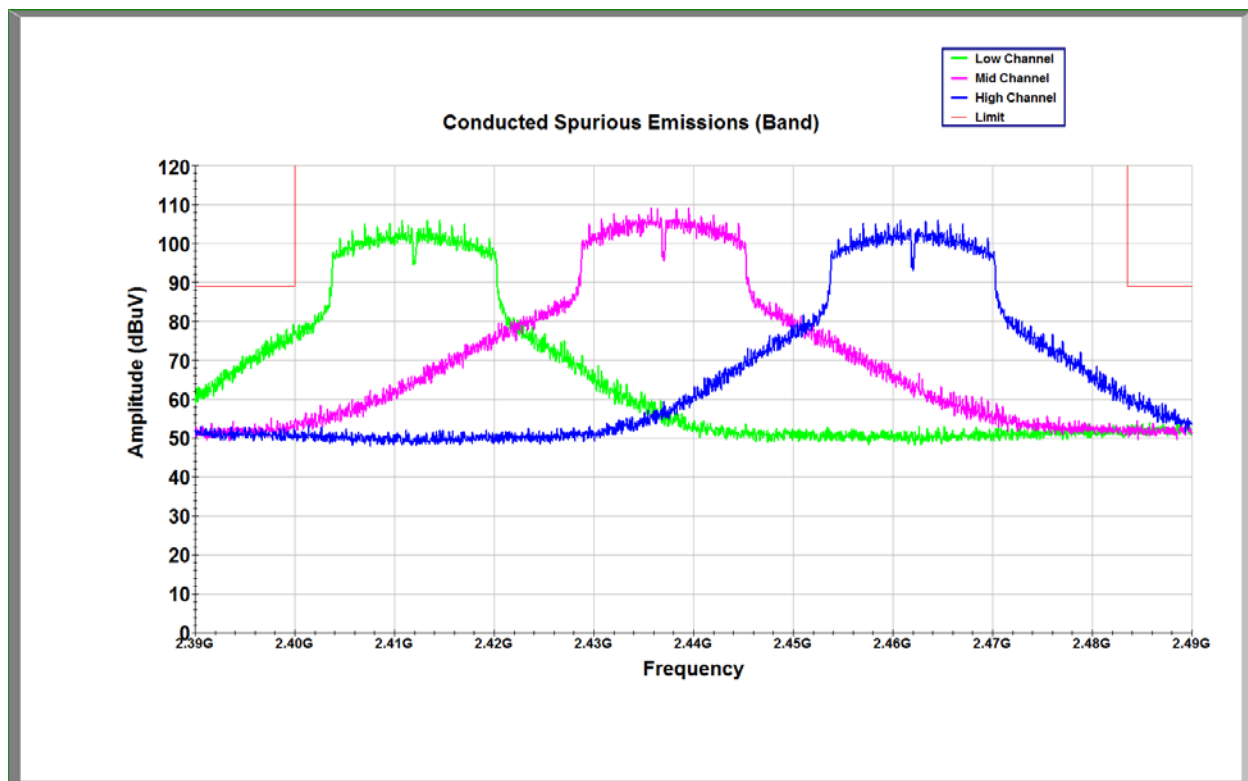
Low Channel Conducted Spurious Emissions - 802.11g Mode



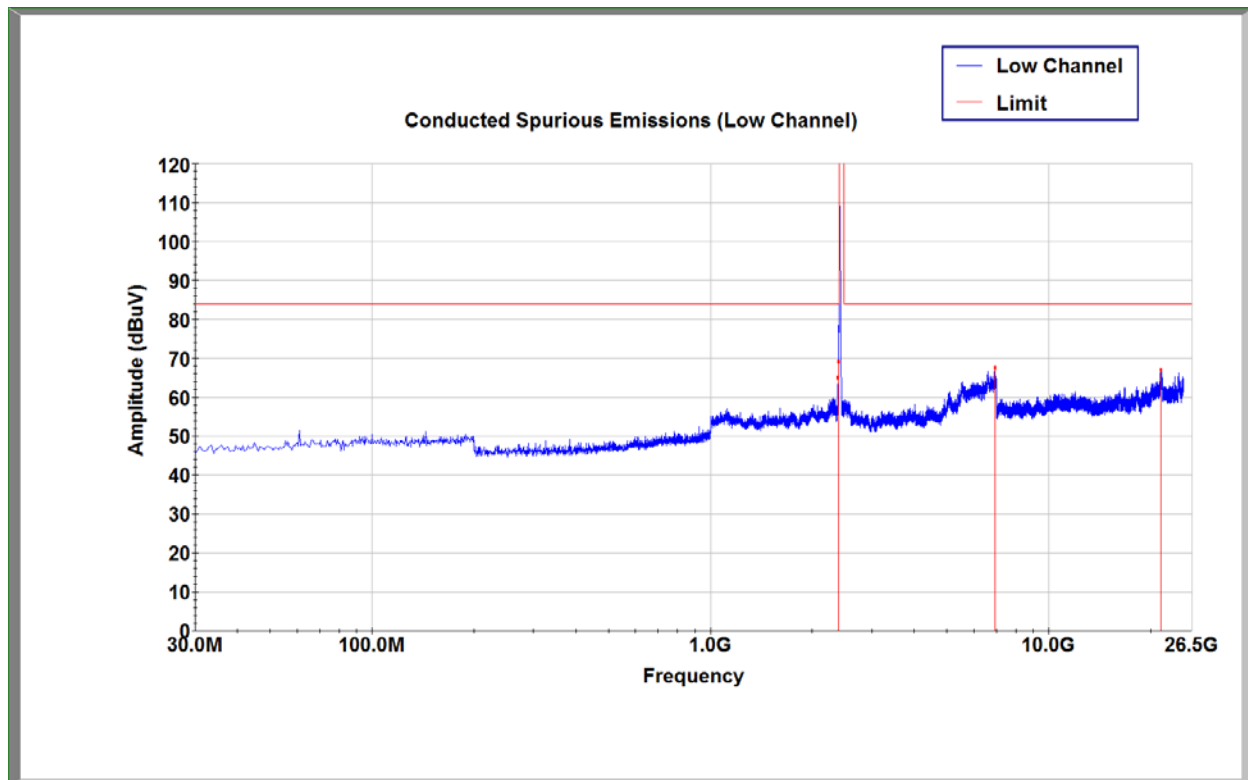
Mid Channel Conducted Spurious Emissions - 802.11g Mode



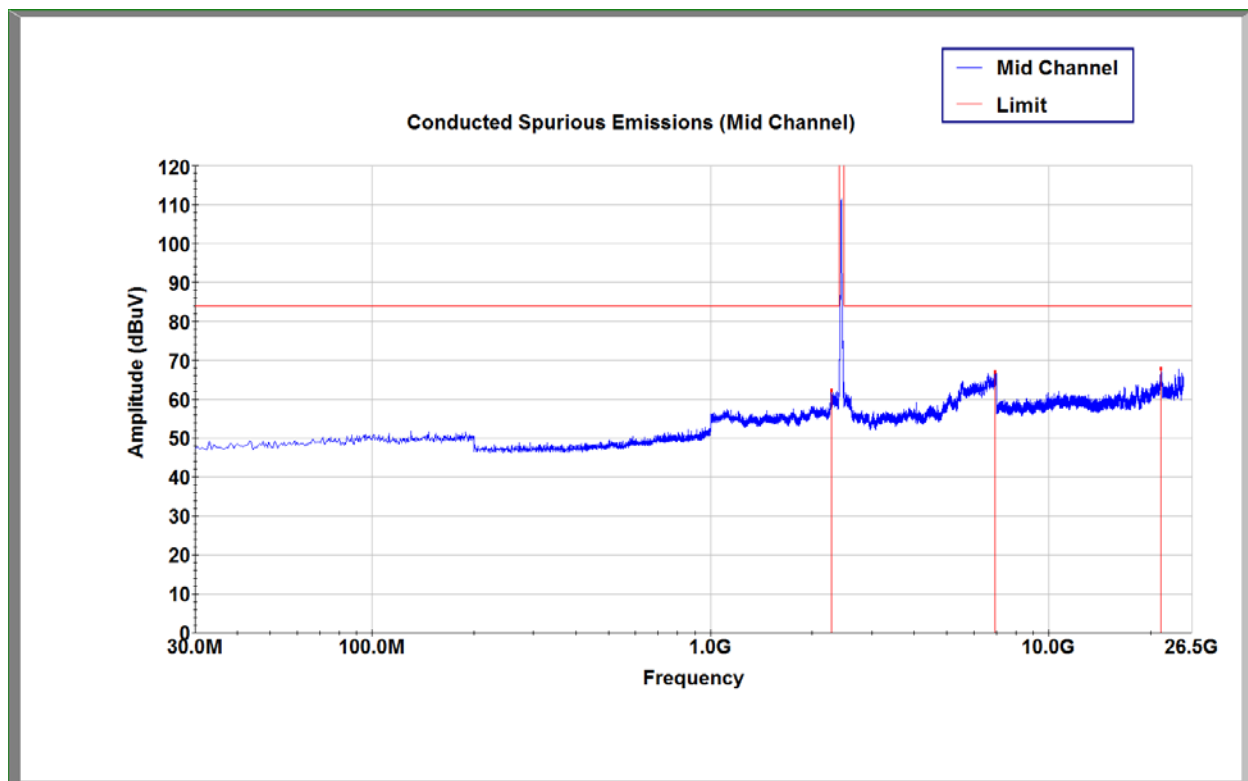
High Channel Conducted Spurious Emissions - 802.11g Mode



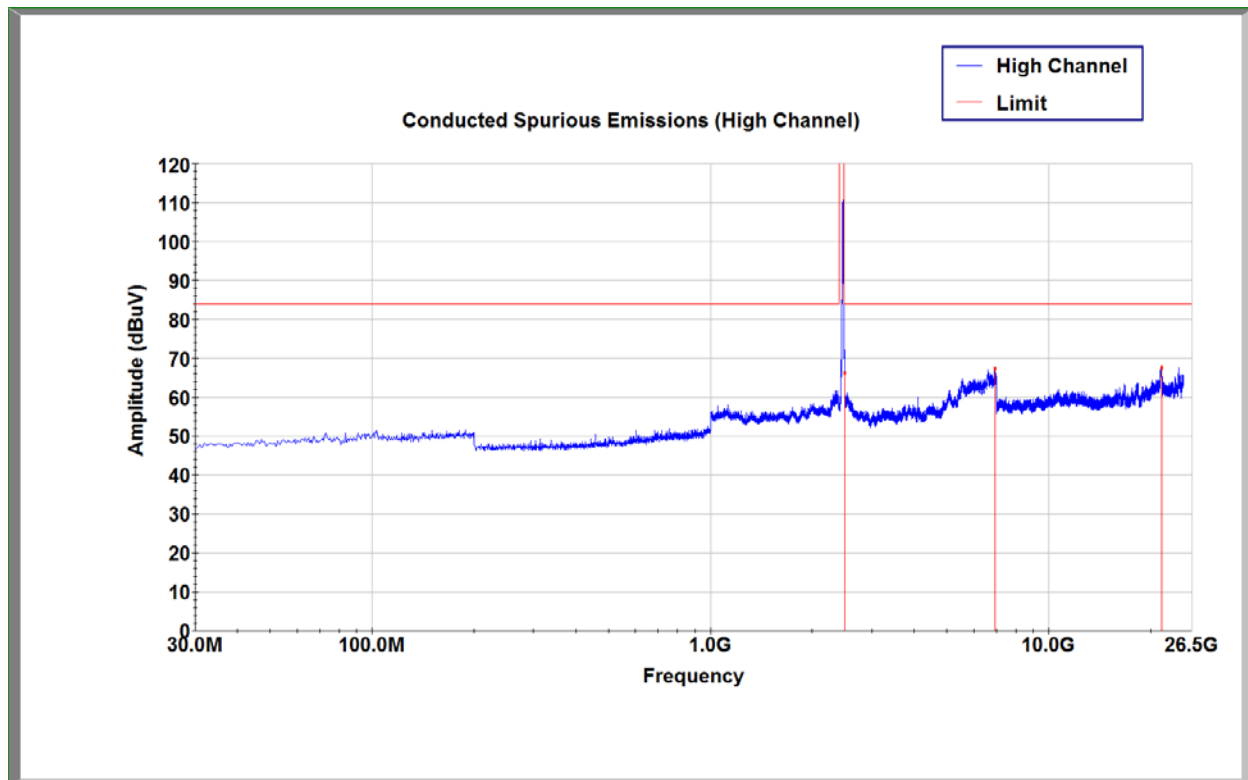
Emissions Close to Band Edge – 802.11g Mode



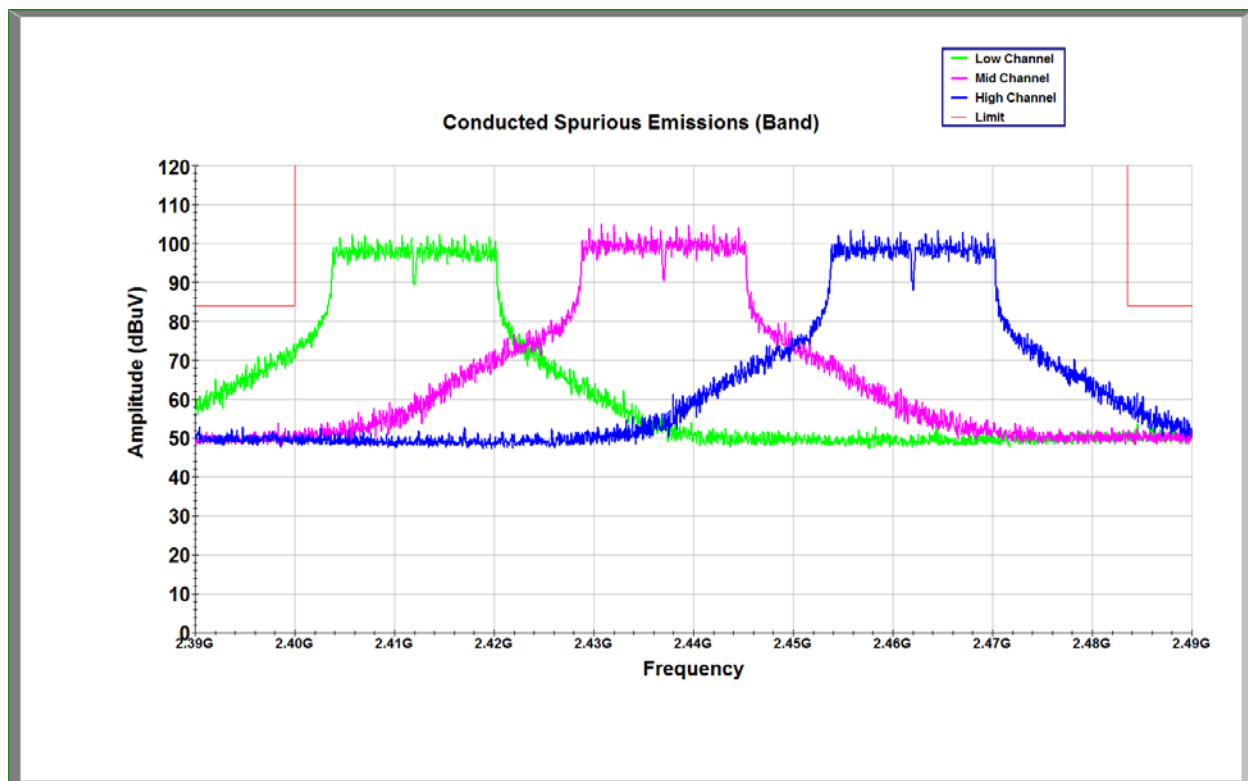
Low Channel Conducted Spurious Emissions - 802.11n Mode



Mid Channel Conducted Spurious Emissions - 802.11n Mode



High Channel Conducted Spurious Emissions - 802.11n Mode



Emissions Close to Band Edge – 802.11n Mode

7 Power Spectral Density

7.1 Test Limits

§ 15.247(e): For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

7.2 Test Procedure

ANSI C63.10: 2013 and KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)

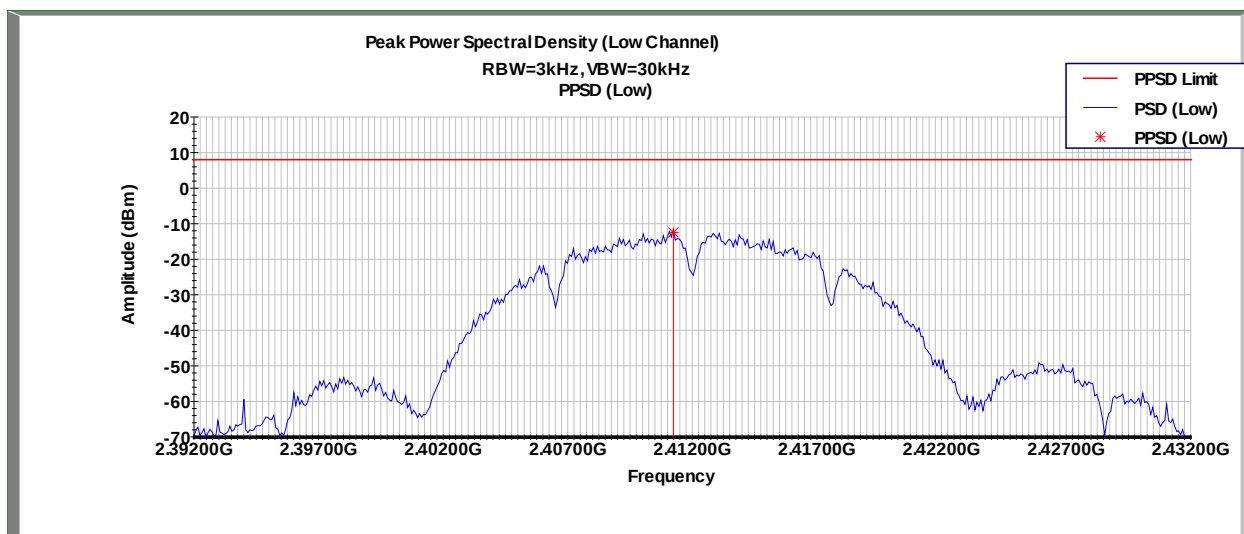
7.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	10887490.26	Rohde & Schwarz	ESI26	9/20/2016	9/20/2017

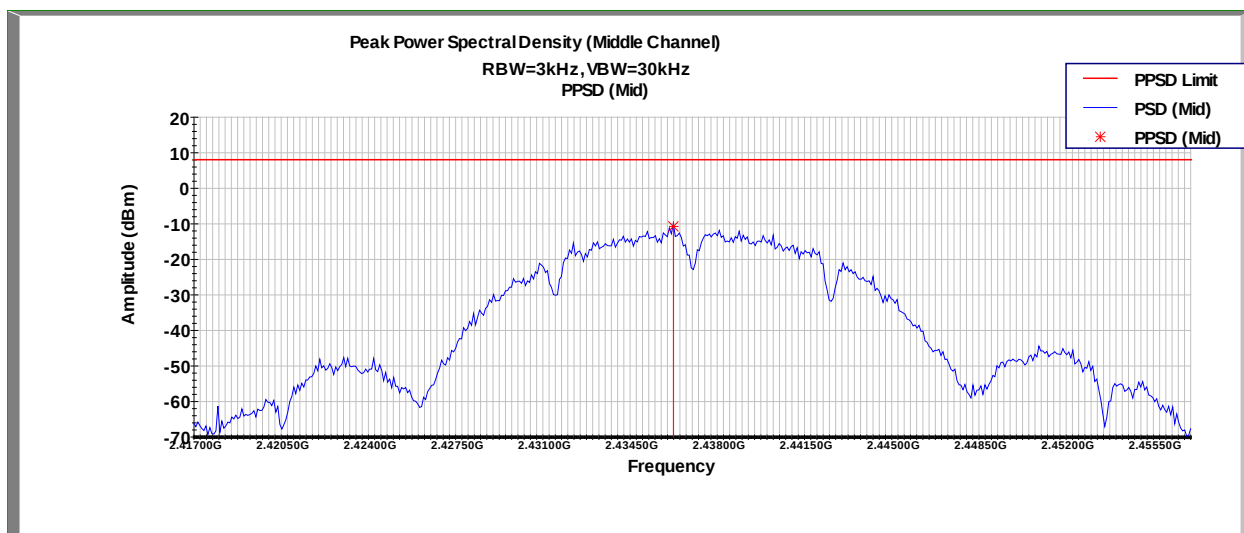
7.4 Results:

*PKPSD Method

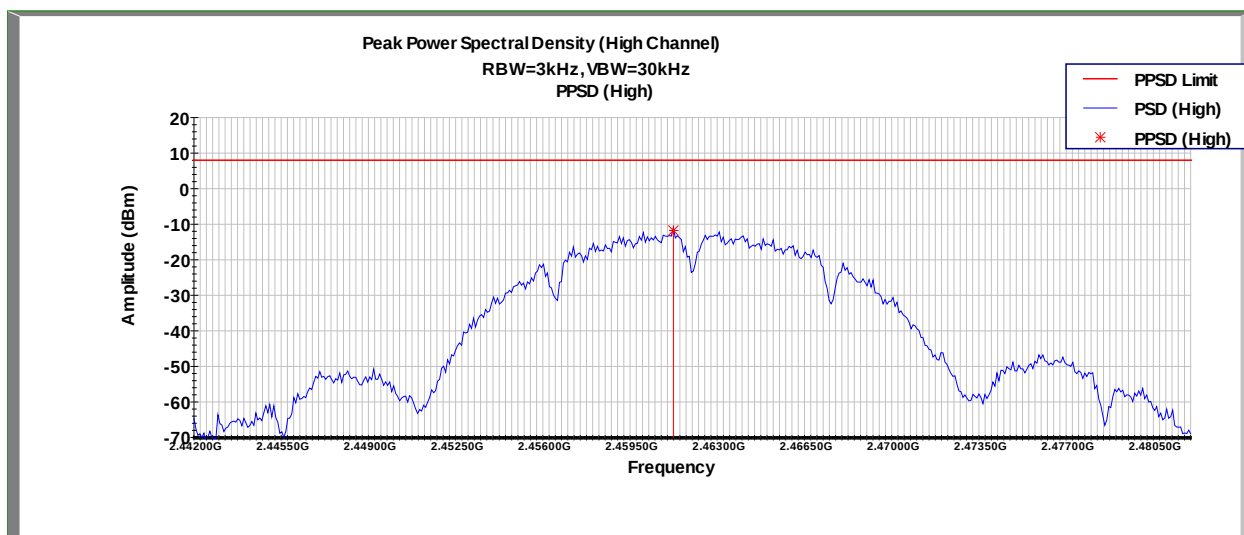
Mode	Channel Number	Frequency (MHz)	PPSD in 3kHz BW (dBm)	Limit (dBm)	Margin (dBm)	Result
802.11b	1	2412	-12.487	8.0	20.487	Pass
802.11b	6	2437	-10.787	8.0	18.787	Pass
802.11b	11	2462	-11.769	8.0	19.769	Pass
802.11g	1	2412	-18.365	8.0	26.365	Pass
802.11g	6	2437	-15.493	8.0	23.493	Pass
802.11g	11	2462	-18.672	8.0	26.672	Pass
802.11n	1	2412	-23.984	8.0	31.984	Pass
802.11n	6	2437	-23.266	8.0	31.266	Pass
802.11n	11	2462	-21.962	8.0	29.962	Pass



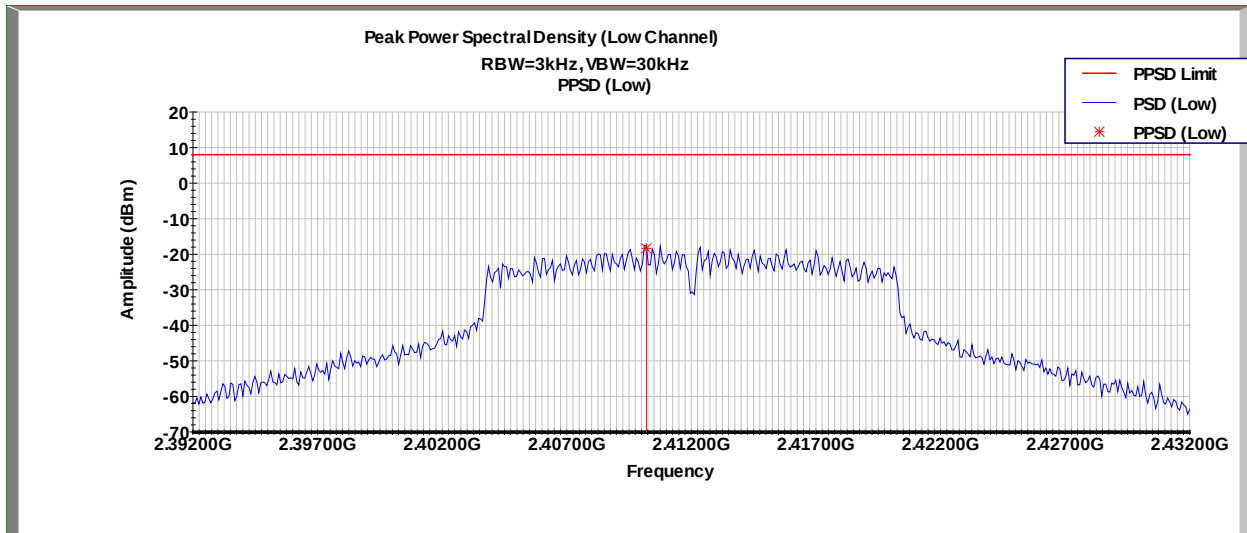
Power Spectral Density – Channel 1 802.11b mode



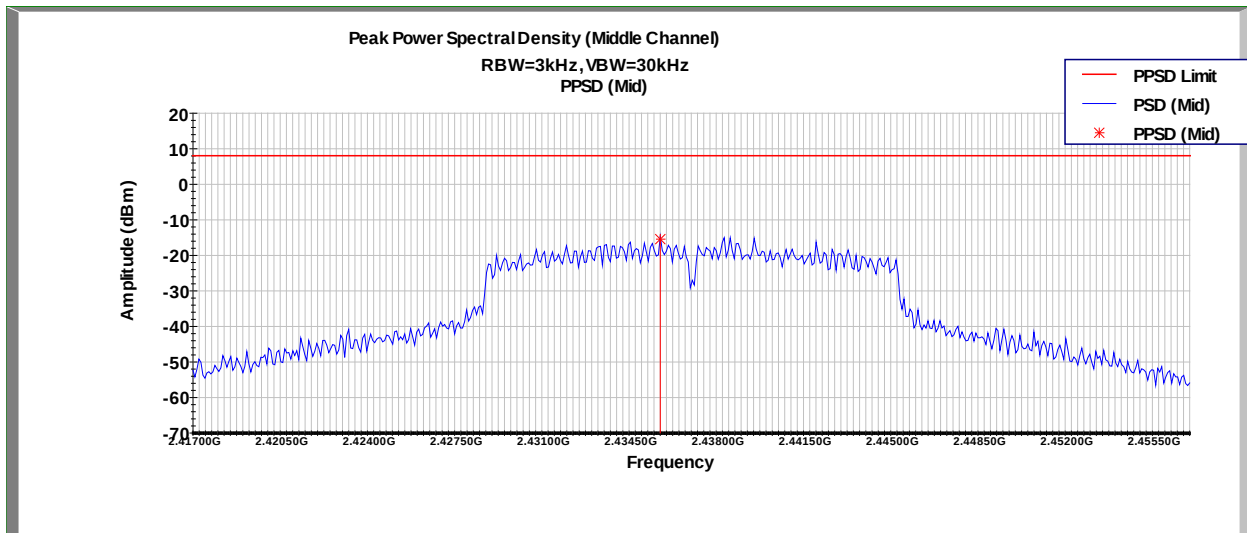
Power Spectral Density – Channel 6 802.11b mode



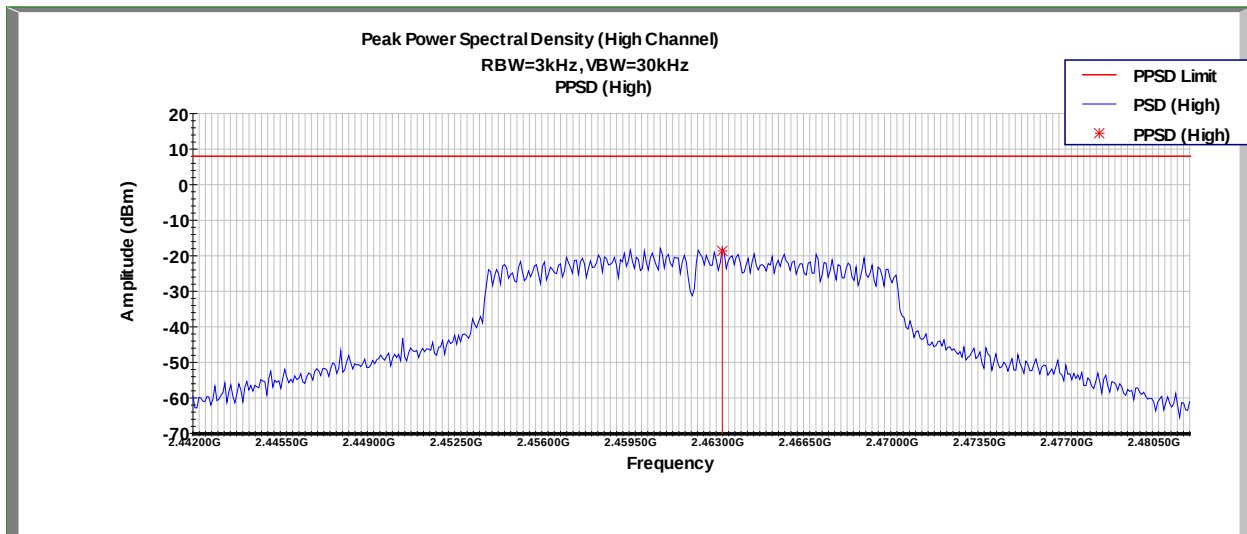
Power Spectral Density – Channel 11 802.11b mode



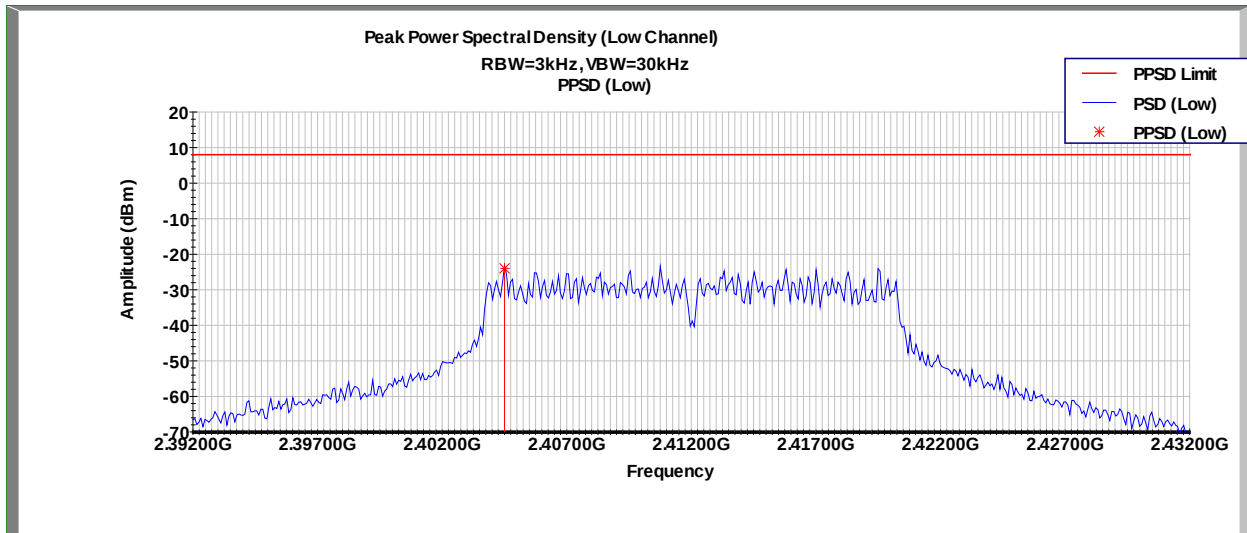
Power Spectral Density – Channel 1 802.11g mode



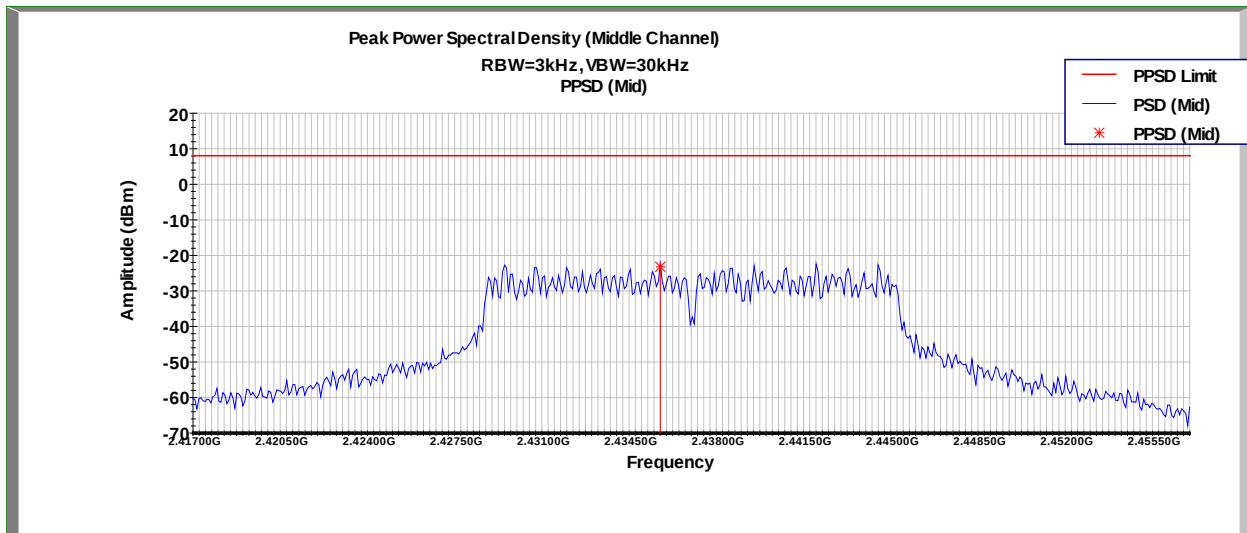
Power Spectral Density – Channel 6 802.11g mode



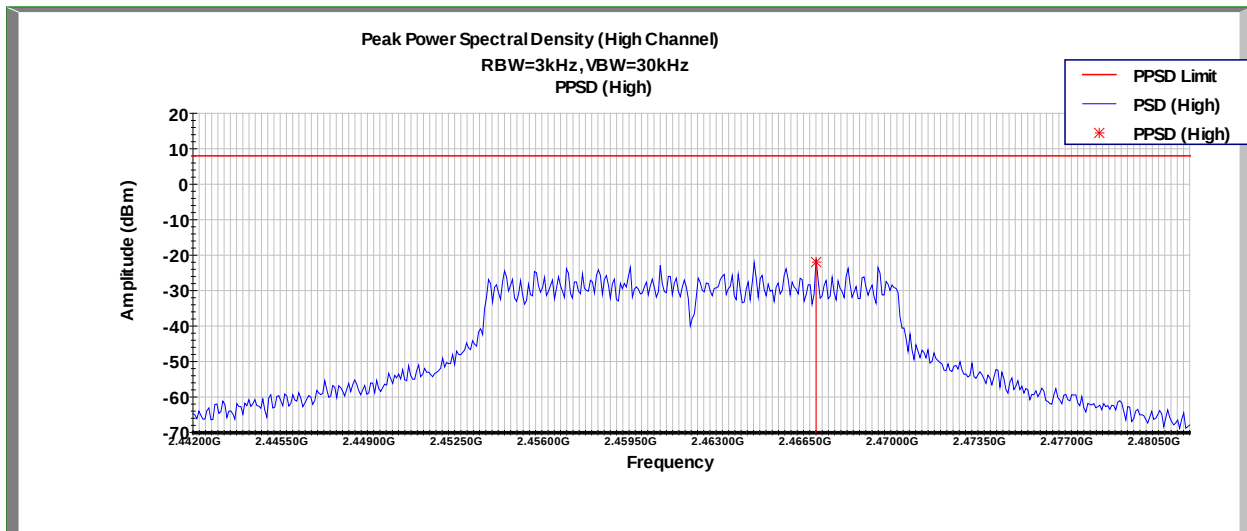
Power Spectral Density – Channel 11 802.11g mode



Power Spectral Density – Channel 1 802.11n mode



Power Spectral Density – Channel 6 802.11n mode



Power Spectral Density – Channel 11 802.11n mode

8 Radiated Spurious Emissions (Transmitter)

8.1 Test Limits

§ 15.247(d): In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Part 15.205(a): Restricted Bands of Operations

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
10.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2655–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	(²)
13.36–13.41			

¹ Until February 1, 1999, this restricted band shall be 0.490–0.510 MHz.

² Above 38.6

Part 15.209(a): Field Strength Limits for Restricted Bands of Operation

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 - 0.490	2,400 / F (kHz)	300
0.490 - 1.705	24,000 / F (kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

8.2 Test Procedure

ANSI C63.10: 2013 and KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)

8.3 Example of Field Strength Calculation Method:

The measured field strength was calculated by summing the readings taken from the spectrum analyzer with the appropriate correction factors associated with the antenna losses and cable losses. The calculation formula and sample calculations are listed below:

Formula:

$$FS = RA + AF + CF$$

FS = Field Strength in dB μ V/m

RA = Receiver Amplitude in dB μ V

AF = Antenna Factor in dB

CF = Cable Attenuation Factor in dB (Including preamplifier and filter attenuation)

Example Calculation:

RA = 19.48 dB μ V

AF = 18.52 dB

CF = 0.78 dB

$$FS = 19.48 + 18.52 + 0.78 = 38.78 \text{ dB}\mu\text{V/m}$$

$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm } [(38.78 \text{ dB}\mu\text{V/m})/20] = 86.89 \mu\text{V/m}$$

8.4 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	10887490.26	Rohde & Schwarz	ESI26	9/20/2016	9/20/2017
Preamplifier	122005	Rohde&Schwarz	TS-PR18	11/17/2016	11/17/2017
Biconnilog Antenna	00051864	ETS	3142C	4/6/2017	4/6/2018
Horn Antenna	154521	ETS	3117	11/14/2016	11/14/2017
System Controller	121701-1	Sunol Sciences	SC99V	Verify at Time of Use	Verify at Time of Use
3m Cable Antenna→Preamp	3074			11/17/2016	11/17/2017
3m Cable Preamp→Chamber	2588			11/17/2016	11/17/2017
3m Cable Chamber→Control Room	2593			11/17/2016	11/17/2017
3m Cable Control Room→Receiver	2592			11/17/2016	11/17/2017
10m Cable Antenna→Preamp	3339			11/17/2016	11/17/2017
10m Cable Preamp→Chamber	3172			11/17/2016	11/17/2017
10m Cable Chamber→Control Room	2590			11/17/2016	11/17/2017
10m Cable Control Room→Receiver	2589			11/17/2016	11/17/2017

8.5 Results:

All spurious emissions were attenuated by at least 20dB below the level of the fundamental as required by Part 15.247(d). Additionally, all emissions falling within restricted bands of operation and at the band edges were found to be below the limit specified in Part 15.209(a). The spurious emissions listed in the following tables are the worst case emissions. Emissions were investigated with the test sample positioned in 3 orthogonal axis and the worst case reported.

Worst Case Spurious Measurements (802.11b Mode)**802.11b Channel 1 Radiated Spurs:**

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4824.000000	43.46	74.00	30.54	1000.000	410.0	H	157.0	7.5
7245.600000	43.87	74.00	30.13	1000.000	202.0	V	235.0	10.4
9648.000000	46.52	74.00	27.48	1000.000	410.0	V	224.0	13.6
12061.200000	50.84	74.00	23.16	1000.000	260.0	H	291.0	17.4
14480.800000	48.53	74.00	25.47	1000.000	200.0	H	183.0	17.2
16890.400000	53.55	74.00	20.45	1000.000	208.0	H	138.0	21.7

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4824.000000	31.63	54.00	22.37	1000.000	410.0	H	157.0	7.5
7245.600000	31.46	54.00	22.54	1000.000	202.0	V	235.0	10.4
9648.000000	34.13	54.00	19.87	1000.000	410.0	V	224.0	13.6
12061.200000	37.21	54.00	16.79	1000.000	260.0	H	291.0	17.4
14480.800000	36.23	54.00	17.77	1000.000	200.0	H	183.0	17.2
16890.400000	41.01	54.00	12.99	1000.000	208.0	H	138.0	21.7

802.11b Channel 6 Radiated Spurs:

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4874.000000	44.38	74.00	29.62	1000.000	339.0	H	254.0	7.4
7310.200000	43.89	74.00	30.11	1000.000	210.0	H	292.0	10.5
9748.000000	47.15	74.00	26.85	1000.000	266.0	V	195.0	13.7
12175.400000	49.63	74.00	24.37	1000.000	221.0	H	152.0	17.2
14631.200000	49.77	74.00	24.23	1000.000	310.0	V	192.0	17.3
17051.400000	53.60	74.00	20.40	1000.000	206.0	V	149.0	21.4

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4874.000000	32.51	54.00	21.49	1000.000	339.0	H	254.0	7.4
7310.200000	31.61	54.00	22.39	1000.000	210.0	H	292.0	10.5
9748.000000	33.72	54.00	20.28	1000.000	266.0	V	195.0	13.7
12175.400000	36.88	54.00	17.12	1000.000	221.0	H	152.0	17.2
14631.200000	36.83	54.00	17.17	1000.000	310.0	V	192.0	17.3
17051.400000	41.11	54.00	12.89	1000.000	206.0	V	149.0	21.4

802.11b Channel 11 Radiated Spurs:

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4915.600000	42.11	74.00	31.89	1000.000	233.0	V	327.0	7.3
7395.200000	44.74	74.00	29.26	1000.000	205.0	H	202.0	10.7
9847.600000	47.07	74.00	26.93	1000.000	381.0	V	202.0	14.0
12300.000000	49.71	74.00	24.29	1000.000	227.0	H	163.0	17.1
14781.600000	50.20	74.00	23.80	1000.000	280.0	H	326.0	17.7
17232.400000	52.83	74.00	21.17	1000.000	286.0	H	212.0	21.0

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4915.600000	29.40	54.00	24.60	1000.000	233.0	V	327.0	7.3
7395.200000	31.31	54.00	22.69	1000.000	205.0	H	202.0	10.7
9847.600000	34.38	54.00	19.62	1000.000	381.0	V	202.0	14.0
12300.000000	37.13	54.00	16.87	1000.000	227.0	H	163.0	17.1
14781.600000	37.27	54.00	16.73	1000.000	280.0	H	326.0	17.7
17232.400000	39.93	54.00	14.07	1000.000	286.0	H	212.0	21.0

Worst Case Spurious Measurements (802.11g Mode)**802.11g Channel 1 Radiated Spurs:**

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4827.600000	42.44	74.00	31.56	1000.000	298.0	V	215.0	7.4
7243.600000	43.74	74.00	30.26	1000.000	218.0	H	265.0	10.4
9657.600000	46.26	74.00	27.74	1000.000	252.0	H	268.0	13.6
12060.800000	49.58	74.00	24.42	1000.000	293.0	H	322.0	17.4
14480.800000	49.32	74.00	24.68	1000.000	252.0	H	142.0	17.2
16890.400000	53.06	74.00	20.94	1000.000	220.0	V	115.0	21.7

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4827.600000	29.78	54.00	24.22	1000.000	298.0	V	215.0	7.4
7243.600000	31.41	54.00	22.59	1000.000	218.0	H	265.0	10.4
9657.600000	33.69	54.00	20.31	1000.000	252.0	H	268.0	13.6
12060.800000	37.09	54.00	16.91	1000.000	293.0	H	322.0	17.4
14480.800000	36.25	54.00	17.75	1000.000	252.0	H	142.0	17.2
16890.400000	41.03	54.00	12.97	1000.000	220.0	V	115.0	21.7

802.11g Channel 6 Radiated Spurs:

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4868.800000	41.99	74.00	32.01	1000.000	370.0	H	260.0	7.4
7309.000000	44.66	74.00	29.34	1000.000	203.0	H	162.0	10.5
9757.600000	46.24	74.00	27.76	1000.000	285.0	V	174.0	13.7
12175.400000	49.62	74.00	24.38	1000.000	239.0	H	146.0	17.2
14631.200000	49.49	74.00	24.51	1000.000	410.0	V	158.0	17.3
17050.600000	54.48	74.00	19.52	1000.000	374.0	H	185.0	21.4

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4868.800000	29.87	54.00	24.13	1000.000	370.0	H	260.0	7.4
7309.000000	31.60	54.00	22.40	1000.000	203.0	H	162.0	10.5
9757.600000	33.81	54.00	20.19	1000.000	285.0	V	174.0	13.7
12175.400000	36.85	54.00	17.15	1000.000	239.0	H	146.0	17.2
14631.200000	36.91	54.00	17.09	1000.000	410.0	V	158.0	17.3
17050.600000	41.09	54.00	12.91	1000.000	374.0	H	185.0	21.4

802.11g Channel 11 Radiated Spurs:

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4915.600000	42.01	74.00	31.99	1000.000	363.0	V	206.0	7.3
7395.200000	44.44	74.00	29.56	1000.000	410.0	H	142.0	10.7
9857.600000	46.56	74.00	27.44	1000.000	204.0	H	121.0	14.0
12300.800000	50.08	74.00	23.92	1000.000	227.0	V	204.0	17.1
14781.200000	49.59	74.00	24.41	1000.000	410.0	V	171.0	17.7
17232.000000	52.61	74.00	21.39	1000.000	410.0	H	124.0	21.0

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4915.600000	29.37	54.00	24.63	1000.000	363.0	V	206.0	7.3
7395.200000	31.24	54.00	22.76	1000.000	410.0	H	142.0	10.7
9857.600000	34.27	54.00	19.73	1000.000	204.0	H	121.0	14.0
12300.800000	37.11	54.00	16.89	1000.000	227.0	V	204.0	17.1
14781.200000	37.25	54.00	16.75	1000.000	410.0	V	171.0	17.7
17232.000000	39.97	54.00	14.03	1000.000	410.0	H	124.0	21.0

Worst Case Spurious Measurements (802.11n Mode)**802.11n Channel 1 Radiated Spurs:**

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4834.000000	42.79	74.00	31.21	1000.000	410.0	V	182.0	7.4
7243.600000	43.89	74.00	30.11	1000.000	202.0	H	168.0	10.4
9652.800000	46.27	74.00	27.73	1000.000	206.0	V	163.0	13.6
12060.400000	50.03	74.00	23.97	1000.000	241.0	H	309.0	17.4
14481.200000	48.37	74.00	25.63	1000.000	216.0	V	254.0	17.2
16890.400000	53.62	74.00	20.38	1000.000	238.0	H	205.0	21.7

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4834.000000	29.72	54.00	24.28	1000.000	410.0	V	182.0	7.4
7243.600000	31.39	54.00	22.61	1000.000	202.0	H	168.0	10.4
9652.800000	33.63	54.00	20.37	1000.000	206.0	V	163.0	13.6
12060.400000	37.18	54.00	16.82	1000.000	241.0	H	309.0	17.4
14481.200000	36.28	54.00	17.72	1000.000	216.0	V	254.0	17.2
16890.400000	41.03	54.00	12.97	1000.000	238.0	H	205.0	21.7

802.11n Channel 6 Radiated Spurs:

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4865.200000	42.72	74.00	31.28	1000.000	374.0	H	199.0	7.4
7303.000000	43.89	74.00	30.11	1000.000	200.0	H	126.0	10.5
9757.600000	46.53	74.00	27.47	1000.000	224.0	V	272.0	13.7
12175.400000	49.79	74.00	24.21	1000.000	215.0	H	207.0	17.2
14631.200000	50.35	74.00	23.65	1000.000	208.0	H	311.0	17.3
17050.200000	53.54	74.00	20.46	1000.000	197.0	V	286.0	21.4

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4865.200000	29.82	54.00	24.18	1000.000	374.0	H	199.0	7.4
7303.000000	31.59	54.00	22.41	1000.000	200.0	H	126.0	10.5
9757.600000	33.82	54.00	20.18	1000.000	224.0	V	272.0	13.7
12175.400000	36.86	54.00	17.14	1000.000	215.0	H	207.0	17.2
14631.200000	36.89	54.00	17.11	1000.000	208.0	H	311.0	17.3
17050.200000	41.08	54.00	12.92	1000.000	197.0	V	286.0	21.4

802.11n Channel 11 Radiated Spurs:

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4916.000000	41.45	74.00	32.55	1000.000	410.0	V	138.0	7.3
7395.200000	44.01	74.00	29.99	1000.000	370.0	V	134.0	10.7
9848.000000	47.43	74.00	26.57	1000.000	410.0	V	209.0	14.0
12302.000000	50.05	74.00	23.95	1000.000	216.0	H	311.0	17.1
14781.200000	50.04	74.00	23.96	1000.000	215.0	H	140.0	17.7
17232.400000	52.43	74.00	21.57	1000.000	218.0	H	143.0	21.0

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4916.000000	29.30	54.00	24.70	1000.000	410.0	V	138.0	7.3
7395.200000	31.27	54.00	22.73	1000.000	370.0	V	134.0	10.7
9848.000000	34.31	54.00	19.69	1000.000	410.0	V	209.0	14.0
12302.000000	37.08	54.00	16.92	1000.000	216.0	H	311.0	17.1
14781.200000	37.22	54.00	16.78	1000.000	215.0	H	140.0	17.7
17232.400000	39.94	54.00	14.06	1000.000	218.0	H	143.0	21.0

Low Channel Band Edge Emissions - 802.11b Mode

Frequency (MHz)	Average (dBμV/m)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2390.000000	---	55.98	74.00	18.02	1000.000	300.0	H	327.0	37.7
2390.000000	44.06	---	54.00	9.94	1000.000	300.0	H	327.0	37.7

High Channel Band Edge - 802.11b Mode

Frequency (MHz)	Average (dBμV/m)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2483.500000	---	53.33	74.00	20.67	1000.000	207.0	H	200.0	37.8
2483.500000	42.87	---	54.00	11.13	1000.000	207.0	H	200.0	37.8

Low Channel Band Edge Emissions - 802.11g Mode

Frequency (MHz)	Average (dBμV/m)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2390.000000	---	52.32	74.00	21.68	1000.000	290.0	V	160.0	37.7
2390.000000	41.87	---	54.00	12.13	1000.000	290.0	V	160.0	37.7

High Channel Band Edge Emissions - 802.11g Mode

Frequency (MHz)	Average (dBμV/m)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2483.500000	---	61.84	74.00	12.16	1000.000	247.0	H	195.0	37.8
2483.500000	43.64	---	54.00	10.36	1000.000	247.0	H	195.0	37.8

Low Channel Band Edge Emissions - 802.11n Mode

Frequency (MHz)	Average (dBμV/m)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2390.000000	---	58.82	74.00	15.18	1000.000	276.0	H	343.0	37.7
2390.000000	41.88	---	54.00	12.12	1000.000	276.0	H	343.0	37.7

High Channel Band Edge Emissions - 802.11n Mode

Frequency (MHz)	Average (dBμV/m)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2483.500000	---	53.40	74.00	20.60	1000.000	283.0	V	151.0	37.8
2483.500000	42.23	---	54.00	11.77	1000.000	283.0	V	151.0	37.8

9 Radiated Spurious Emissions (Receiver)

9.1 Test Limits

§ 15.109: Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency of emission (MHz)	Field strength (microvolts/meter)	Field strength (dBuV/m)
30–88	100	40
88–216	150	43.5
216–960	200	46
Above 960	500	54

These limits are identical to those in RSS-GEN

9.2 Test Procedure

ANSI C63.4: 2014

9.3 Example of Field Strength Calculation Method:

The measured field strength was calculated by summing the readings taken from the spectrum analyzer with the appropriate correction factors associated with the antenna losses and cable losses. The calculation formula and sample calculations are listed below:

Formula:

$$FS = RA + AF + CF$$

FS = Field Strength in dB μ V/m

RA = Receiver Amplitude in dB μ V

AF = Antenna Factor in dB

CF = Cable Attenuation Factor in dB (Including preamplifier and filter attenuation)

Example Calculation:

$$RA = 19.48 \text{ dB}\mu\text{V}$$

$$AF = 18.52 \text{ dB}$$

$$CF = 0.78 \text{ dB}$$

$$FS = 19.48 + 18.52 + 0.78 = 38.78 \text{ dB}\mu\text{V/m}$$

$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm} [(38.78 \text{ dB}\mu\text{V/m})/20] = 86.89 \mu\text{V/m}$$

9.4 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	10887490.26	Rohde & Schwarz	ESI26	9/20/2016	9/20/2017
Preamplifier	122005	Rohde&Schwarz	TS-PR18	11/17/2016	11/17/2017
Biconnilog Antenna	00051864	ETS	3142C	4/6/2017	4/6/2018
Horn Antenna	154521	ETS	3117	11/14/2016	11/14/2017
System Controller	121701-1	Sunol Sciences	SC99V	Verify at Time of Use	Verify at Time of Use
3m Cable Antenna→Preamp	3074			11/17/2016	11/17/2017
3m Cable Preamp→Chamber	2588			11/17/2016	11/17/2017
3m Cable Chamber→Control Room	2593			11/17/2016	11/17/2017
3m Cable Control Room→Receiver	2592			11/17/2016	11/17/2017
10m Cable Antenna→Preamp	3339			11/17/2016	11/17/2017
10m Cable Preamp→Chamber	3172			11/17/2016	11/17/2017
10m Cable Chamber→Control Room	2590			11/17/2016	11/17/2017
10m Cable Control Room→Receiver	2589			11/17/2016	11/17/2017

9.5 Results:

All spurious emissions with the test sample in receive mode were below the limits specified in Part 15.109 for a class B digital device and RSS-GEN Section 6.1.

9.6 Test Data

Quasi-Peak Measurements below 1000 MHz:

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
53.038000	30.68	40.00	9.32	120.000	104.6	V	19.0	15.8
53.324000	30.93	40.00	9.07	120.000	104.8	V	36.0	15.8
53.426000	30.79	40.00	9.21	120.000	105.1	V	309.0	15.8
53.456000	30.54	40.00	9.46	120.000	109.2	V	28.0	15.8
53.720000	30.45	40.00	9.55	120.000	104.5	V	71.0	15.8
79.411000	25.60	40.00	14.4	120.000	110.0	V	229.0	15.6
107.360000	25.75	43.50	17.75	120.000	109.2	V	135.0	16.8
128.980000	28.42	43.50	15.08	120.000	104.5	V	146.0	16.1
687.720000	40.71	46.00	5.29	120.000	224.9	V	236.0	33.1
993.700000	45.65	46.00	0.35	120.000	248.9	V	-2.0	36.6

Peak Measurements above 1000 MHz:

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1218.804500	34.32	74.00	39.68	1000.000	174.0	H	25.0	-1.2
1302.077000	33.98	74.00	40.02	1000.000	143.0	V	50.0	-1.2
2463.577000	47.86	74.00	26.14	1000.000	165.0	V	30.0	3.9
4702.635000	42.67	74.00	31.33	1000.000	148.0	V	36.0	7.7
5497.920000	46.66	74.00	27.34	1000.000	100.0	V	0.0	9.4

Average Measurements above 1000 MHz:

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1218.804500	21.93	54.00	32.07	1000.000	174.0	H	25.0	-1.2
1302.077000	21.69	54.00	32.31	1000.000	143.0	V	50.0	-1.2
2463.577000	27.19	54.00	26.81	1000.000	165.0	V	30.0	3.9
4702.635000	29.89	54.00	24.11	1000.000	148.0	V	36.0	7.7
5497.920000	37.76	54.00	16.24	1000.000	100.0	V	0.0	9.4

10 AC Powerline Conducted Emissions

10.1 Test Limits

§ 15.107(e): Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

*Decreases with the logarithm of the frequency.

10.2 Test Procedure

ANSI C63.4: 2014

10.3 Test Equipment Used:

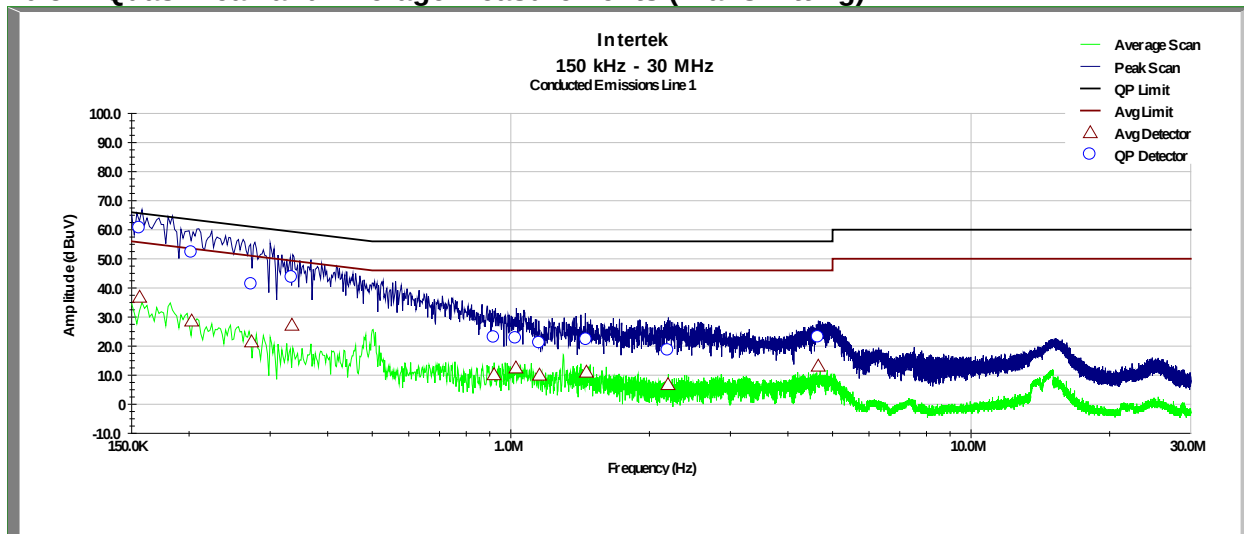
Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	10887490.26	Rohde & Schwarz	ESI26	9/20/2016	9/20/2017
LISN	2509	Fischer Custom Communication	FCC-LISN-50-50-2M	4/6/2017	4/6/2018
Cable	Cond2			11/19/2016	11/19/2017

10.4 Results:

The device was found **to comply**.

10.5 Test Data:

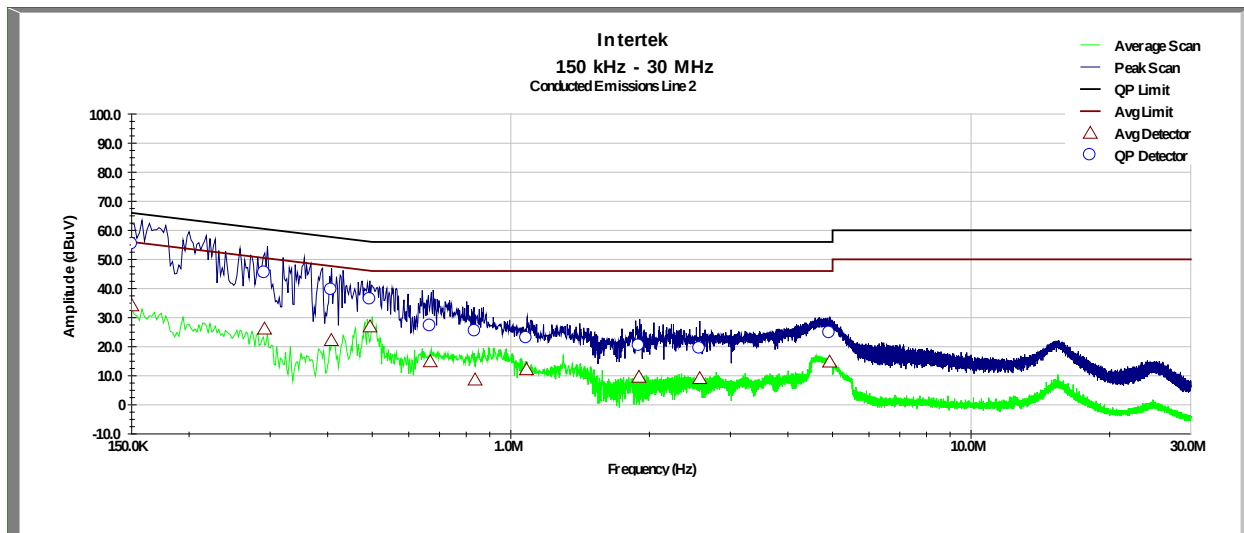
10.5.1 Quasi-Peak and Average Measurements (Transmitting)



Line

Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
0.1561	60.505	65.826	5.321	36.813	55.826	19.013
0.2026	52.159	64.497	12.338	28.597	54.497	25.900
0.2734	41.176	62.474	21.298	21.450	52.474	31.024
0.3344	43.551	60.731	17.180	27.166	50.731	23.566
0.9194	22.906	56.000	33.094	10.124	46.000	35.876
1.026	22.639	56.000	33.361	12.466	46.000	33.534
1.154	20.975	56.000	35.025	9.999	46.000	36.001
1.460	22.128	56.000	33.872	11.016	46.000	34.984
2.195	18.439	56.000	37.561	6.740	46.000	39.260
4.657	22.955	56.000	33.045	13.087	46.000	32.913

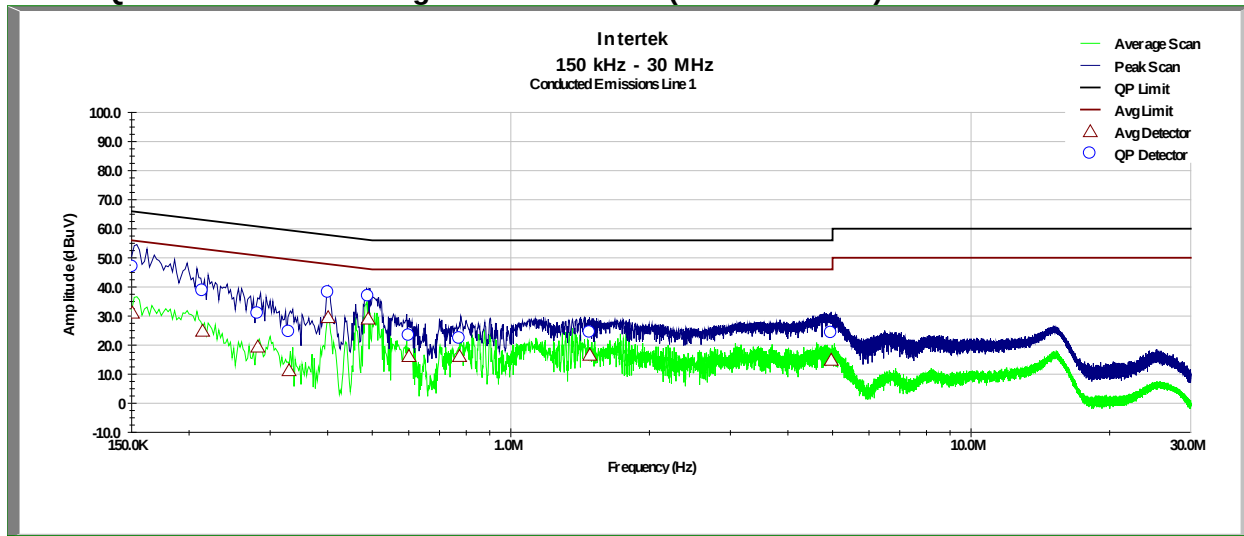
Line



Neutral

Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
0.1502	55.198	65.994	10.796	34.026	55.994	21.969
0.2916	45.347	61.954	16.607	26.048	51.954	25.906
0.4074	39.542	58.646	19.104	22.107	48.646	26.539
0.4944	36.236	56.160	19.924	26.788	46.160	19.372
0.6682	27.076	56.000	28.924	14.795	46.000	31.205
0.8363	25.291	56.000	30.709	8.529	46.000	37.471
1.082	22.875	56.000	33.125	12.059	46.000	33.941
1.898	20.261	56.000	35.739	9.488	46.000	36.512
2.573	19.326	56.000	36.674	9.018	46.000	36.982
4.927	24.667	56.000	31.333	14.711	46.000	31.289

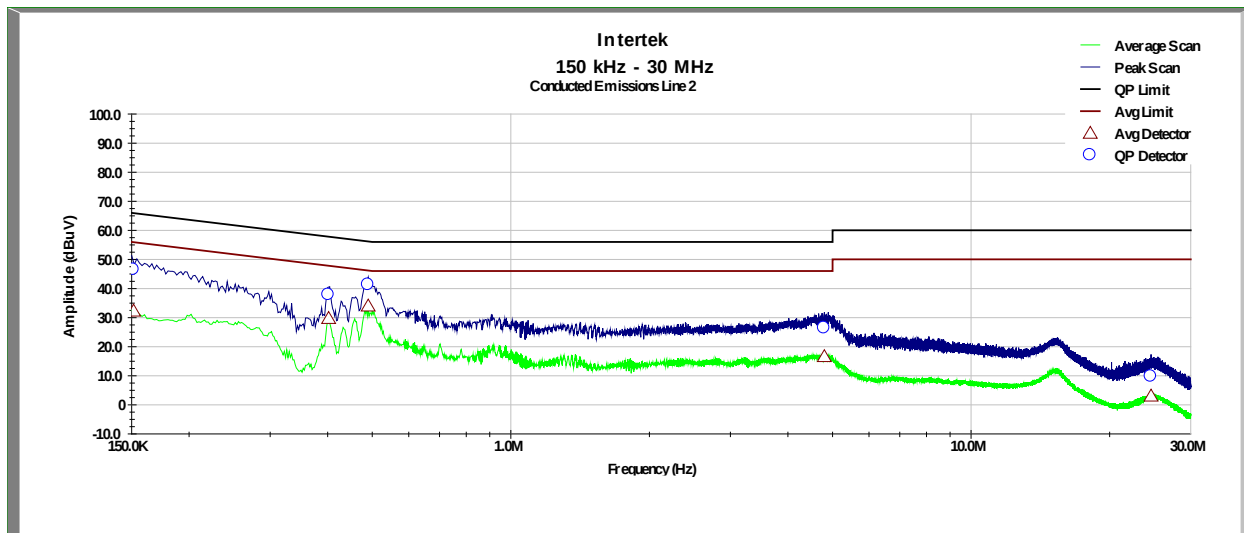
Neutral

10.5.2 Quasi-Peak and Average Measurements (Receive Mode)

Line

Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
0.1506	46.840	65.983	19.143	30.987	55.983	24.996
0.2139	38.607	64.174	25.567	24.767	54.174	29.407
0.2820	30.823	62.229	31.406	19.311	52.229	32.918
0.3297	24.479	60.866	36.386	11.181	50.866	39.685
0.4010	38.008	58.829	20.821	29.449	48.829	19.379
0.4900	36.748	56.286	19.538	28.956	46.286	17.330
0.6006	23.185	56.000	32.815	16.056	46.000	29.944
0.7736	22.188	56.000	33.812	16.084	46.000	29.916
1.484	24.281	56.000	31.719	16.507	46.000	29.493
4.968	24.150	56.000	31.850	14.763	46.000	31.237

Line



Neutral

Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
0.1527	52.730	65.923	13.193	37.166	55.923	18.757
0.2363	37.173	63.534	26.361	21.191	53.534	32.343
0.3244	34.352	61.017	26.665	20.325	51.017	30.692
0.4391	31.896	57.740	25.844	21.558	47.740	26.182
3.429	29.399	56.000	26.601	20.379	46.000	25.621
15.605	32.490	60.000	27.510	26.207	50.000	23.793
17.409	26.837	60.000	33.163	19.266	50.000	30.734
18.496	28.958	60.000	31.042	21.590	50.000	28.410
23.570	25.480	60.000	34.520	19.127	50.000	30.873
25.508	16.832	60.000	43.168	11.181	50.000	38.819

Neutral

11 Antenna Requirement per FCC Part 15.203

11.1 Test Limits

§ 15.203: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

11.2 Results:

The sample tested met the antenna requirement. The antenna used was permanently attached and internal to the unit.

12 Measurement Uncertainty

The measured value related to the corresponding limit will be used to decide whether the equipment meets the requirements.

The measurement uncertainty figures were calculated and correspond to a coverage factor of $k = 2$, providing a confidence level of respectively 95.45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian).

Measurement uncertainty Table

Parameter	Uncertainty	Notes
Radiated emissions, 30 to 1000 MHz	+3.9dB	
Radiated emissions, 1 to 18 GHz	+4.2dB	
Radiated emissions, 18 to 40 GHz	+4.3dB	
Power Port Conducted emissions, 150kHz to 30 MHz	± 2.8 dB	

13 Revision History

Revision Level	Date	Report Number	Notes
0	5/30/2017	103017087LEX-004	Original Issue